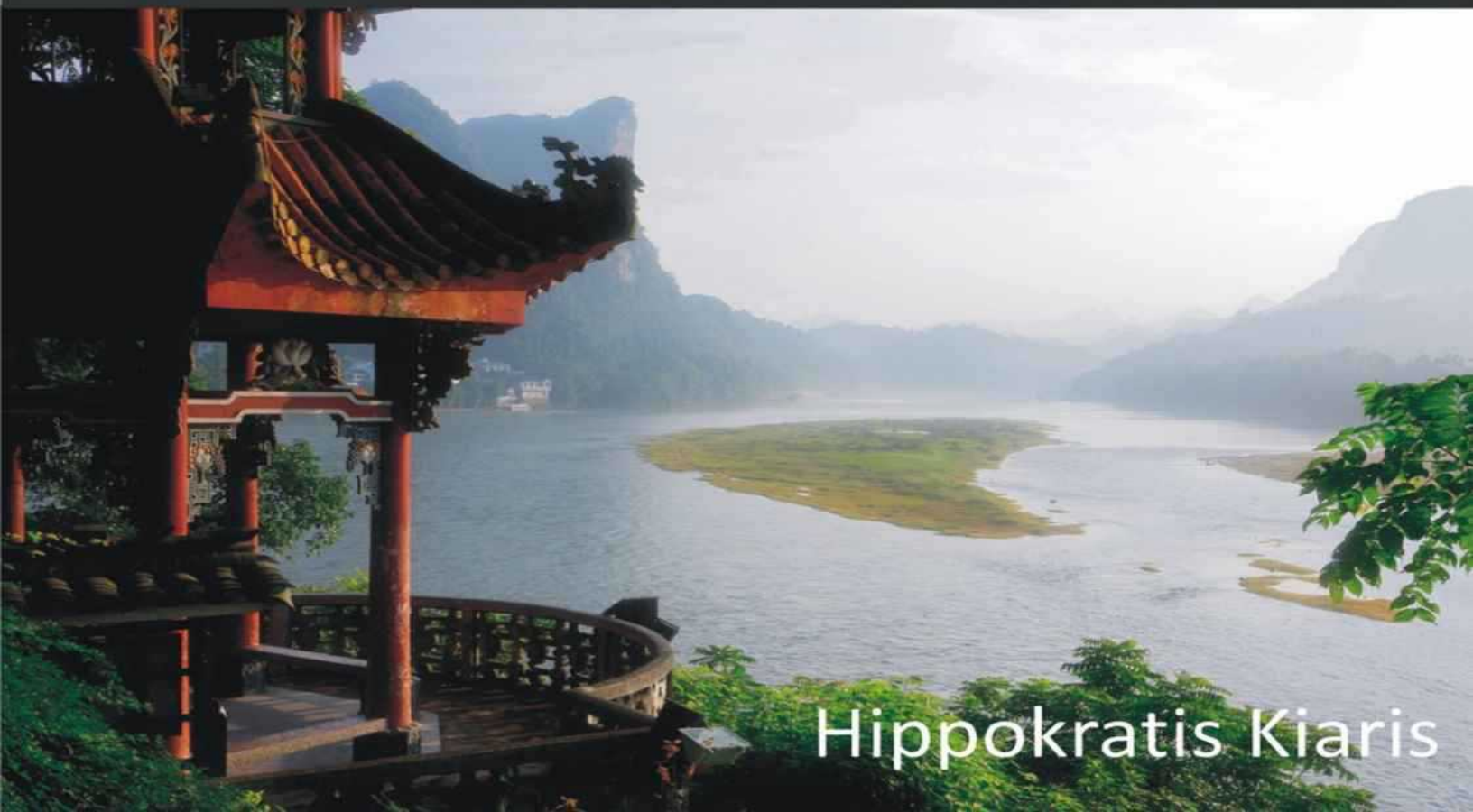
GENES, POLYMORPHISMS AND THE MAKING OF SOCIETIES

How Genetic Behavioral Traits Influence Human Cultures



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To my lovely wife Ioulia,
and to my adorable kids Frosini and Harry,
for their patience and inspiration

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Preface

I am neither a geneticist nor a historian or anthropologist. As a biologist by training, I have received some academic and formal training in genetics. My knowledge—that is, ignorance, actually—in history and cultural anthropology is only empirical and superficial. Therefore, by having this excuse, I hope that I will avoid the rigorous critique from the academic experts in these fields. To such experts, my thoughts may seem naive and oversimplistic, or that I have "reinvented the wheel"—which, intellectually, is even worse. With these reservations constantly accompanying my endeavor, I have continued writing this book.

The issues I attempt to explore all spin around one central question: Why the different populations around the world have developed different and distinct cultures that eventually led to different historical outcomes and different ways, according to which the corresponding societies have been organized, and, in general, distinct ways by which life has been viewed and perceived. These and other relevant questions are examined in view of the different frequencies in various genetic polymorphisms in genes affecting behavior. Furthermore, I attempt to focus on a comparative outline, both cultural and genetic, of peoples and populations from the two major cultural lines and civilizations that have appeared in human history and persist until today: the Eastern (Asian) and Western (European and American). In other words, these questions are reduced to why the Western line of thought has been dominated by Aristotle's *reason* and *logic,* while the Eastern line of thought has been dominated by Confucius's *harmony, collectivism, and context dependency* . The main idea of this book is that the presence of different genes in the corresponding people has actually dictated the acquisition of these distinct cultural and historical lines, and that an alternative outcome might have been unlikely. Based on current trends related to the globalization of cultures and economies, some predictions are

finally being made on the development of human cultures and the potential future of human history .

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PART 1

INTRODUCTION

1. The Concept

The central notion of this book is based on a very simple idea—so simple that it can be considered as self-evident. If the genetic content (status, variability, signature) of individuals, affects—if not dictates—behavior, then shouldn't this content also affect collective decisions and actions, if examined at the level of groups of people that share certain genetic characteristics? Shouldn't people that are genetically similar among each other exhibit similar trends in their decisions that have affected their culture and history? Such groups of people, with a genetically distinct identity, can be considered as entire nations or even what we call races and ethnic groups. No matter how stringent the definition of homogeneity is, especially genetic homogeneity, it is really arbitrary and quantitative. In any case, though, it involves groups of people that genetically are more uniform than people that may belong to other "groups" of people. Therefore, it is conceivable that history, at least the part of it that reflects the outcome of certain decisions and reactions of human individuals, is also affected by the genetic identity of the people involved. In other words, different people would have made different choices that, in turn, would have created a different outcome to their history.

This notion is applicable at the various levels of organization of such groups, from families in which the genetic relations are so apparent, to the anthropological bands and tribes and races—notwithstanding that there is not a scientific consensus regarding what, exactly, the human races are or how many (Molnar, 2005). This term historically was defined by using a combination of both biological and socio-cultural criteria. Regardless of whether Asian people can be classified into five or fifty groups, whether or not they represent a distinct and single "race" or many different races, it is clear that they are in principle more "identical" among each other and distinct as regards their physical characteristics when compared to European people, and vice versa. This is due to the existence of several

features among them that largely reflect (and are reflected to) their genetic identity. Not that all Europeans can pass as Europeans by looking only at their physical appearance, or Asians for Asians. Many cases exist of individuals with intermediate (or mixed) characteristics that point to the fact that there is a continuum in the intensity of these features. Thus, a certain grey zone exists that does not allow drawing strict barriers among different populations. This often involves traits that manifest in lower frequencies in certain groups while they are more common in other groups of people, or features that are stronger in the one group and milder in the other. This can be due to the occasionally extended interbreeding during certain historical periods between people of different ethnic groups, as well as to the even more important fact that there is not a single genetic characteristic present in all people of the same population and absent from all others. Thus, a single (and objective) criterion to classify an individual as a member of a specific race does not exist. It is all a matter of frequencies, ratios, and intensities—but we'll come back to that later. We'll see in some detail in subsequent chapters that characteristics, such as the epicanthic fold or the double eyelid, are considered typical for East Asians and are usually accompanied by light skin color. At the same time, though, we have also seen individuals that belong to Western populations who have considerably darker-than-average color skin types, accompanied by pronounced double eyelids, characteristics that are considered more "typical" for African and East Asian people respectively. Frequently, notwithstanding not exclusively, in the world of show-biz, such exceptions and deviations from the mainstream characteristics are more common than in the average population, which probably implies the attraction these "minority" traits elicit—a fact that possesses apparent implications in providing certain mating advantages!

At this point, it also has to be emphasized that notions related to the genetic classification and the eventual categorization of the various races are obviously wrong scientifically, and are completely outside the intentions of this book. Even when we subsequently describe examples of certain genetic features that superficially may be taken as disadvantages, we have to keep in mind that those should be judged as such only within the certain context that they have appeared and stabilized in a given population. Certain examples point to the fact that even disease-related genes, such as

those responsible for the development of sickle cell anemia and Glucose-6-phosphate dehydrogenase (G6PD) deficiency, have an eventual role in conferring resistance against infectious diseases. Thus, what can be viewed as a disadvantage in the first instance is certainly an advantage within a given environment. Many more are the cases of genes that, while not responsible per se, can modulate the development or the severity of specific diseases and have a different prevalence among people of different origin.

Obviously, since even in cases that involve pathological conditions the distinction between “harmful” and “beneficial” is not clear-cut, when we talk about behavioral traits, the whole picture becomes even more complicated. It is much more complex to classify a characteristic as purely advantageous or disadvantageous for the individual that bears it when we focus on characteristics that affect human behavior and personality. For example, novelty-seeking is a behavioral trait related to the tendency for increased risk-taking and exploratory excitability. This trait, historically, might have produced a positive influence in individuals, since it might have facilitated progress and advancement. It is noteworthy to mention that it has also been related, genetically and behaviorally, with increased incidences of drug addiction. Does this remind you of Western people (or people of European descent) and their civilizations? How about the observation that the specific polymorphism that is related to this trait is quite uncommon in Asians?

As we will see in subsequent chapters, recent complex analyses and genetic modeling suggest that these polymorphisms, such as those related to novelty-seeking, are likely associated with the migratory patterns of human populations, providing a direct hint on how genetics might affect the history of certain people. And not coincidentally, speaking about the migratory pattern of behavior, the easier (or more efficient) adaptation into a new environment is intrinsically linked to novelty-seeking behavior. We will discuss all of these issues in much greater detail in subsequent chapters, along with other analogous traits. Thus, what is positive in a specific view can be negative in another. The level of complexity increases even more by the observation that certain genetic traits, depending on the exact conditions that are being studied, may affect a variety of behavioral trends and

patterns, and what we see and record is actually the collective outcome of all these behavioral variables.

Another issue that may arise throughout this book is related to the concept of "free will." In that sense, genetically speaking, the unavoidable question is this: How free is our will if we are actually hardwired, or at least predisposed, against certain behaviors, choices, and reactions that differ among individuals? I admit that I will not attempt to deal with such questions since, after all, these are rather philosophical issues, and it is not my intention to approach them. However, no matter what the correct answer may be, our only rational option in life, both as individual persons and as members of a larger group or community, is to keep on trying to extract the best out of what we have. Within this context, as individual persons we experience the option for a will that is really free.

Keeping these issues in mind, my whole point is that different people respond or are more likely to respond differently against similar stimuli, and that these responses are likely more common among people that are more similar genetically. The latter is quite likely to occur with people that belong to a group or population with similar (or more homogenous) genetic imprint. Thus, if against the same stimulus or during an encounter, A people are more possible to elicit a type-K response while B people are likely to elicit a type-L response, then A and B people are likely to take consecutively different decisions through historical time: The A people will repeatedly respond with a K-type response while the B people respond with an L-type response. And, importantly, the genetically similar offspring of these people will continue to make similar decisions whenever they face similar challenges, thus exhibiting an apparent consistency in the building of their culture and norms. These decisions eventually will be reflected in their collective history. If, for example, this K-response is to retreat and negotiate when they deal with offensive actions, while the L-response involves confrontation and "fight back" decisions, then it is quite likely that A people will be less prone to warrior-type cultures than B people. We can also imagine that another genetically regulated trait exists that makes A people more cooperative than B people. It is conceivable in that case to expect that the A people will develop cultures and societies at which their individual members will exhibit increased interdependency than the B

people. Thus, their cultures will be more “collective,” when compared to those of the B people, who in turn will have a tendency toward individualistic cultures. Of course, the unbiased question is whether such genetically regulated traits exist that can affect those types of cultural and historical decisions. This is a main focus of this book, and we will try to address it in subsequent chapters.

Consistent with these notions, it is not only the socioeconomical environment, the geography, the natural phenomena, the occurrence of certain disasters and diseases or other exogenous factors that have affected and will continue to affect the history of humans, but also the genetic signature of the people. Therefore, in any attempt to explain human history, the genetic profile of the corresponding people should also be taken into consideration, along with the other conventional parameters. Even if this is not feasible technically as yet, it is rather likely that in the near future it can be. And in that case, we can even go one step further; besides explaining the past, we might also be able to “predict” the future. This may sound like a science-fiction scenario right now, but if we were able to “measure” behavioral tendencies and the genetic structures of given societies, then the prediction of possible outcomes against specific conditions could be made.

That this “runs in the family” does not only refer to diseases or certain physical features, but also to behaviors, our likes and dislikes that, conventionally, we used to attribute only to certain socio-environmental factors—in other words, to the way we “grew up.” For example, that ancient Greeks (or, to use a present-day example, the Kennedy family) were deeply political may reflect, at least in part, their genetic signature. A certain predisposition against specific behaviors, such as the tendency of not taking things and conditions as a given, in combination with the desire to lead, may manifest as an attraction to politics.

Not that the environment—in its widest sense—is not playing a major role, of course. On the contrary, actually! However, in order to formulate characters and mentalities (as well as physical characteristics and diseases), the environment needs to interact with the given genetic background, and the result will be as specific as it can be for each individual. Thus, the behavioral pattern that emerges is not the sole result of the environment, but

is also greatly affected by the genetic information carried by each and every person as well. This is, of course, a given, a basic and elementary knowledge of biologists. The notion of context dependency ranges from the study of the genetic basis of behavioral traits, and it affects the interpretations of those attempting to understand the response of individuals against certain stimuli, to the elucidation of the effects of the (micro)-environment in cellular differentiation and disease. Or to why the same carcinogens cause cancer in some individuals but not in others. It is increasingly appreciated that the magnitude and the extent of any biological response is greatly influenced by the genes of the individual.

In a reductive approach on addressing how genes affect behavior, the emphasis is given to the prediction of how individuals will respond to a specific (socio-economical) environment, or in other terms, to the building up of "characters" and personalities in their wider sense. It is reasonable, though, to speculate that analogous mechanisms will also operate at a larger scale as well, at the level of populations, and in that case, the outcome will be reflected not to individuals' decisions, but rather to collective decisions that are capable of affecting history. We can read in J. M. Roberts's classic book *A Short History of the World* (1997) that "[H]uman history began when the inheritance of genetics and behavior which had until then provided the only means of survival was first broken through by conscious choice" and "[I]t (human culture) was increasingly built by deliberate selection…" (p. 2). The question, in that case, is related to how strictly we define the terms "broken through by conscious choice" as well as "deliberate," and on whether all conceivable options indeed carry the same probability for different groups of people…

2. Genes, Polymorphisms, and Genetic Heterogeneity

Individuals are different. They differ in their physical appearance, their specific abilities, their inherent risk to get sick from certain diseases, their characters, and their entire existence. Depending on the particular characteristics we are studying, such differences can be attributed, to some degree, to the individual's DNA, or in other words, to the genes that someone has inherited from his or her mother and father. For some characteristics, the contribution of the genes is absolute and apparent, while for others, the environment may play an equal or even more important role than that of the genes. Thus, while our eye color is solely determined by our genes, our character and behavior are also determined by the conditions we grew up in, our friends, our family, and, in general by the environment, or alternatively, by nurture [1] . Again, even in the case of traits that are so obviously shaped by socio-environmental factors, a not negligible genetic contribution is there. Savings behavior, for example, a trait that is thought to be affected grossly by the environment, was (according to a recent report) found to have a substantial genetic component (Cronqvist & Siegel, 2010). Interestingly, according to this study, the strength of the genetic expression of savings behavior is modulated by whether the subject grew up in a supportive environment, exemplifying the interplay between "nature" and "nurture" in a behavioral trait.

What are these genetic polymorphisms that underline our individual identity? Let's turn to some basic concepts. Simply speaking, the term refers to the existence of different "versions" of the same genes that, while in principle are identical, exhibit a slightly different activity. This is due to slight differences in their structure (primary sequence) or their regulatory regions. The differences can be quantitative (for example, stronger or weaker activity of some enzymes) or qualitative (such as a product with

different color). It is noted, though, that most of the time, these qualitative differences can be reduced to differences in the activity (quantity) or the amount of the pigment for color-related phenotypes, but for our purposes this doesn't make any actual difference.

The variation between individuals in virtually all their physical characteristics is due to such polymorphisms, or in other words, due to the fact that different persons carry different versions (and the combinations) of the genes. This is why two brothers can have different color of hair, two sisters have different skin types, or a father has wet-type earwax while his son has the dry type. It's just because they have inherited different versions of the genes that control these traits. Given that humans have about 22,000 genes, and that many of them are polymorphic, the combinations are practically unlimited. Furthermore, many genes have more than two polymorphic alleles, a fact that increases the possibilities even more. This is the genetic basis of human variation, or vice versa, human individuality.

The reason this variation exists is usually related to the evolutionary and adaptation processes, as well as to phenomena associated to pure randomness. In many cases, the benefits conferred by certain alleles and the resulting characteristics are apparent. For example, in human populations, darker colors in the skin confer increased protection against harmful sunrays. This is the reason that darker skin colors are more common in populations closer to the equator, since people in these places are exposed to more time in the sun. On the other hand, since sunlight is also important for the metabolism of vitamin D, people who have darker skin color (due to increased amounts of melatonin) in geographic areas with little sunlight, such as in the northern climates, often have deficiencies in vitamin D. So, what is an advantage under certain conditions can be a disadvantage under different conditions. Obviously, the specific environmental conditions play an important role in attributing a certain genetic feature with a beneficial or negative character.

In other cases, the advantages are more obscure and hard to identify, such as in the case of the earwax type, for which the dry-type has been proposed to be an adaptation against colder climates. Even the variability in a "minor" characteristic, such as earwax type, can produce benefits affecting

the domination of one population over another, reflecting the cumulative power and magnitude that even slight genetic variation may have in whole populations. Of course, new alleles, or different versions of the same genes, do not necessarily need to offer selective advantages in order to be stabilized in a population. Even more importantly, these new genetic variants do not necessarily need to offer such advantages instantly, at the time they appeared in the individuals. They may just be present in the population, increasing the variability and waiting for the conditions to change so natural selection and evolution can utilize them. Thus, it is not only natural selection that drives evolution. Other complex phenomena, such as genetic drift, may account for this stabilization. Genetic drift essentially incorporates random phenomena that affect the frequency of alleles and are stronger in smaller populations. So, if a new genetic variant appears suddenly in a small and relatively isolated population, it may be stabilized and eventually dominate this population, even if it doesn't affect the individual's survival (Ridley, 2003; Futuyma, 2009).

By an analogous manner, it is known that certain diseases are controlled by specific "sick" versions of genes (more accurately speaking, genes encoding for products related to sickness or disease), while others regulate our predisposition or modulate our possibility (or risk) to get a disease. In other words, their presence operates as a genetic risk factor for certain conditions. The stabilization of these "sick" genes within a population occasionally may also be associated to an advantage contributed by these genes in a certain environmental context. In sickle cell anemia, for example, the allele that is related to the disease, when it is found in heterozygosity (one copy of the sick gene and one copy of the normal or wild type allele in diploid organisms, such as humans), renders individuals more resistant to malaria, and this is the reason it is more common in geographical areas with higher malaria incidence. In other cases, disease-related genes may be stabilized in certain populations due to cultural and other phenomena that are not related directly to the genes' function. One such example is the relatively high prevalence of Usher syndrome in Samaritans that causes congenital deafness. Samaritans are related genetically to Jews in terms of being descendants of a group of Israelite inhabitants. While in ancient times they exceeded a population of one million, today there are just a few hundred, and they are considered as one of the more highly inbred

populations of humans. Due to the high degree of inbreeding and their relatively low population numbers, a specific mutation in chromosome 11 that causes Usher syndrome has been stabilized in this population. Thus, individuals that have inherited two copies of this gene from their parents suffer from deafness (Bonné-Tamir et al., 1997).

Whenever an apparent association does not exist between the presence of certain "disease"-related alleles and specific advantages, while cultural and historical parameters cannot explain their presence, the reasons that account for these alleles not having been eliminated from the general population remain under debate and beyond the scope of this book. In any case, though, it has to be kept constantly in our minds that natural selection, by definition, is a constant process that never ends, and what we see now is only a snapshot of evolution. So, in other words, what we see now is not an evolutionary end-point at which the selection processes have been completed and the best possible outcome produced. There is always the possibility that what we see as a negative trait today will be eliminated in the future or turn out to be advantageous when the conditions change. Or new mutations may appear in specific genes that, due to an advantage they offer, the individuals bearing them may increase in numbers and the corresponding alleles may be stabilized in the population. In that latter case, we may even witness that other alleles located in the vicinity of these advantageous alleles may also be favored, indirectly.

While the whole situation, in terms of genetic contribution, is relatively clear, as regards some well-defined physical conditions and characteristics, in discussing behavioral traits the landscape is by far more elusive, and thus the corresponding scientific controversies more vivid. The explanation is simple, and it is related to both the complexity of these characteristics in terms of how the corresponding genetic loci control the development of behavioral traits, as well as the not precisely understood, and indeed defined, contribution of the environment to behavior. Simply speaking, it is easier to identify the contribution of nutrition as an environmental factor in regulating, besides his genes, someone's height (or for a smoker with a history for lung cancer, the possibility to get the disease) in the presence or absence of specific polymorphic alleles, than understand whether some

violent behavior, besides the environment, is also due to the genetics of the individual.

On top of that, the scientific and conceptual limitations are reinforced by the public sensitivity—that is not frequently irrational—against these notions that restrict these studies. Speaking about how society, in terms of a given cultural context, might judge and classify behaviors and behavioral traits, it is also noted that these are not static notions, but are rather dynamic and are highly influenced by the socio-cultural environment and the historical time-point we refer to. These notions are illustrated very nicely by studying how different and occasionally extreme behaviors were considered (or not) to be pathological in different historical periods. Such issues are discussed, among others, in high detail and depth by Michel Foucault in his classic *History of Madness* (2006). Thus, if even the borderline between normal and pathological is not strict and objective, then it is understandable why the classification of an individual's trait A as A1 or A2 type is also inconclusive at the least.

Despite those—conceptual or not—limitations, a lot of progress has been made and various behavioral traits have been linked to specific genetic variations. Or, vice versa, certain polymorphisms have been linked to an increased probability against specific behaviors. The term "probability" is of particular importance because it indicates that merely having the gene doesn't mean that someone will develop the trait, but rather that he has higher or lower chances to do so. Or, alternatively, among a group of people that carry the gene, only a fraction will develop the trait. These "chances" (reflected by the genetic penetrance of the trait) among others are determined by the interaction of the gene with the environment. In other cases, they are attributed to pure randomness or stochastic phenomena.

Naturally, the precise manifestation of these behaviors, their degree or level of expression, and their exact type are formulated by environmental factors, as well, but undoubtedly, the genes we carry also play a major role in the determination of personality. In several cases, a link between various traits and specific genetic loci has been reported with some being better supported by the experimental evidence than others. Those include, but are not limited to, behaviors such as the exploratory activity, novelty-seeking,

tendency for aggression, social behavior, or even risk-taking behavior related to financial decisions. Genetic variations in (brain-) hormones, neurotransmitters, their corresponding receptors, and other proteins related to their metabolism or physiology, are the usual suspects. The role of neuro-hormones in the decision process has recently been described, among several other interesting examples, by Lehrer in his book *How We Decide* (2009). This observation is not surprising, considering the pleiotropic action of such hormones and their involvement in determining our behavior and responses. As we will discuss in detail in subsequent chapters, an example is offered by the polymorphisms in the serotonin transporter gene. Serotonin, or 5 -hydroxytryptamine (5-HT), is a neurotransmitter that is derived by the modification of the amino acid tryptophan. Amino acids are the building blocks of proteins; tryptophan is one among 20 of those. Among other tissues, tryptophan can be found in the central nervous system. It is acting via specific receptors that, in turn, can affect the activity of other neurotransmitters, such as epinephrine, dopamine, and achetylcho-line. Serotonin levels are regulated depending on specific internal and external stimuli, and have been associated with various behaviors and conditions, such as appetite, mood, emotion, and sleep. Proper activity of serotonin is facilitated by serotonin transporter (5-HTTLPR), a protein responsible for the re-uptake of serotonin from the synaptic cleft. Importantly, the gene encoding for this transporter protein is polymorphic. A certain polymorphism in the promoter region of this gene that corresponds to the gene's regulatory region, which determines when it will be activated, results in two versions of the gene: a long version (*l*) and a short version (*s*), with the latter associated with reduced transcriptional activity and, thus, decreased availability of the serotonin transporter. As regards a potential link of 5-HTTLRP and behavior, the long allele has been associated, among other traits, with "happiness," while the short allele with anxiety and impulsivity. It's worth noting that the short version of 5-HTTLRP is found in Asian populations almost twice as much as in Caucasians, with considerable variation among Europeans.

This book attempts to explore various selected behavioral traits in view of their potential contribution in shaping cultures, history, and eventually historical decisions. The genetics of these traits will also be discussed in light of the prevalence of specific polymorphisms in different ethnic groups

and how such differences may account for the different characteristics between people of different races, or how they might have affected their culture and history.

The study of various polymorphisms in different human populations is also of great interest to anthropologists; however, such studies usually focus on the distribution of these polymorphisms. By using them as markers, biological anthropologists attempt to identify similarities or divergences between different populations, patterns of migration and intermixing, and other factors related to those characteristics. Besides that function, such "meaningful" polymorphisms may also exhibit occasionally a specific contribution to behavior and may affect differentially some general trends or traits in various distinct populations. This latter notion is the main focus of this book. We will concentrate particularly on the "comparison" between people of Asian and Western origin, since these people exemplify the two major cultural lines of humankind. By analyzing cultural trends and characteristics of Eastern as opposed to Western civilization, we will explore whether they are in line with specific genetic trends described for these people, which in turn may indicate the existence of a causal association between genes and cultures.

2.1. Genetic Markers and Analysis

When talking about polymorphisms and different versions of our DNA, it has to be mentioned that it is not all our DNA that corresponds to genes (that, in turn, and as mentioned before, comes into different versions). Actually, the vast portion of our DNA, at the magnitude of about 98%, is "junk." It doesn't have any specific function (as far as we know), but it's still there. And it exhibits even stronger variability, or polymorphic incidence, than the coding DNA between individuals. This is not surprising, considering that it isn't the subject of evolutionary pressure. The two major —and genetically useful—sources of variation in the DNA correspond to small changes in the repetition number of certain core, repetitive sequences, or base substitutions (that occasionally, if they are found within the gene's coding sequence, don't change the corresponding protein). The onset of a mutation in a protein-coding segment of DNA can quite possibly affect the cell's—and, by extrapolation, the individual's—viability. Whether a certain

protein has a version with activity one fold or two fold, due to polymorphisms in its genomic sequence, it is quite possible to affect some physiological process, with the one version being “better” than the other, at least within a given environment.

Most of the time, these mutations are eliminated because pure chance in their occurrence is more likely to generate “bad” alleles. Infrequently, these random genetic events are associated with the contribution of a beneficial feature, a sort of advantage, and eventually they will dominate the population if they contribute to the individual’s (mating at the end) performance, or the performance of the group as an entity (in cases of group selection). This is the essence of evolution and refers to the cases at which the changes interfere with some kind of activity or overall efficiency. [2] On the other hand, if the mutation has targeted a non-coding segment of our genome, namely our “junk” DNA, it is not going to affect the individual’s viability. In these cases, and by mechanisms that do not directly involve selective processes, they can be stabilized in the population and passed into the subsequent generations by following of “unbiased” inheritance. The term “unbiased,” in this case, refers to the fact that the chances of inheritance into the subsequent generations of any of the two potential alleles are equal. This is the case with most of these non-coding polymorphisms, unless they are close to other coding sequences that also exhibit variability. In that case, the non-coding polymorphisms “benefit” from the selection that operates onto these coding polymorphisms and may increase (or decrease) in frequency in a population. Thus, they are benefitted by their good (or bad) neighbors. Not infrequently, geneticists identify a specific polymorphism that is associated with a particular genetic trait and try to understand if this polymorphism bears a functional significance or if it is just close to other polymorphisms that carry this functional significance.

The absence of evolutionary pressure in these sequences renders the corresponding polymorphisms ideal genetic markers (Griffiths et al., 2000). This is, among others, of particular importance in tracing the fate and history of DNA sequences and is also useful in order to identify the physical location of genes that are associated with certain traits and diseases. If, for example, a certain polymorphism is seen in populations A

and B but not in C, it is quite reasonable to assume that A and B people are somehow more closely related among each other than with the C people. Now, if we also take into consideration their geographic location, our conclusions can also be extended to migration events and the history of these populations. Analogous and even more refined conclusions can be obtained if we take into consideration, instead of their mere presence or absence, the frequencies of these polymorphisms in the corresponding populations, as well. In subsequent chapters, we will describe the results of such analyses and how, for example, they offered us clues regarding the migratory events that resulted in the colonization of the European continent. If, on the other hand, among the same population a specific polymorphism is found more frequently among people with a certain trait (or disease), then it is quite reasonable to conclude that either causally (as part of a coding or regulatory DNA sequence) or due to its close proximity with a functional genetic variation, this polymorphism is associated with the onset of the corresponding trait.

Of use in genetic analyses, particularly those related to anthropological studies, is mitochondrial DNA. The mitochondrion is a cellular organelle that works as the cell's power plant. Noteworthy, it comes with its own DNA, a short, circular, 16,000-base pair long DNA segment that, surprisingly, in its structure bears greater similarity to the DNA of some bacteria than with the cell's chromosomal DNA. Actually, it is considered that mitochondria trace their cellular ancestors to bacteria that "decided" during a certain evolutionary step to live together with other cells that are the ancestors of eukaryotic cells, quitting permanently their individual identity.

An important aspect in their biology, besides their obscure prokaryotic-like structure, is their maternal mode of inheritance. Namely, all of our mitochondrial DNA comes exclusively from our mothers, who, in turn, received it from their mothers, and so on. Interestingly, even this mitochondrial DNA is polymorphic, a fact that renders it particularly useful and informative when we examine maternal lines of genetic inheritance. Thus, by tracing the polymorphisms in our mothers, we may track down our maternal ancestors. Indeed, as it will be discussed in greater detail in the next chapter, the concept of our maternal ancestor, who has been called the

“Black” or “Mitochondrial” Eve, has originally been formulated and supported by studies of polymorphisms utilizing mitochondrial DNA samples obtained from different populations.

3. Biological Anthropology and the Distribution of Human Populations As We Know Them Today

Homo sapiens [3] acquired its formal name during the eighteenth century from the Swedish botanist and zoologist Carl Linnaeus. By observing the differences in the physical characteristics among individuals, he went a step further, dividing humans into four subspecies: *Homo sapiens europaeus* , *Homo sapiens americanus* , *Homo sapiens asiaticus,* and *Homo sapiens afer* or *africanus* (Marks, 1995). Color played a major role in this classification, corresponding to white, red, yellow, and black skin, respectively. His conviction that this classification was extended beyond skin color was so strong that he attributed certain behavioral characteristics to each of these taxa. So, according to Linnaeus, the individuals that were classified as *Homo sapiens afer* were relaxed, crafty, and negligent, while those of the *Asiaticus* taxon were avaricious and distracted easily. Native Americans, or *Homo sapiens americanus,* were stubborn, merry, and easily angered, while *Homo sapiens europaeus* were gentle, active, smart, and inventive. Finally, he also proposed another variation within humans, termed *Homo sapiens monstrosus,* [4] which include people with deformities, relatively unknown groups such as the Khoikhoi people of South Africa, as well as other fantastic people.

While, of course, such classifications are both ethically unacceptable and scientifically wrong, among others they signify the fact that a high degree of variability exists between human beings and that this variability is not random but is rather associated with a specific geographical distribution. In other words, it is more likely to find black people in Africa than in Northern

Europe and people with double eyelids in East Asia than in the Mediterranean. Furthermore, it implies that certain behavioral traits might also be associated with specific populations. Of course, the presence of certain features is neither necessary nor sufficient to derive conclusions regarding the geographic origin of individuals. It is just correlative and denotes what is more likely to be than what actually is .

In order to trace the source of this variability among human beings and its distribution, we have to travel back a few million years, to the time when the earliest ancestors of the evolutionary line that ultimately resulted in the appearance of *Homo sapiens* can be identified. Technological developments, new findings, and alternative interpretations of existing experimental data constantly appear in the scientific literature that continuously change the details of this story; however, the outline is not distal from what I will describe below. Olson (2002) and Sykes (2002), in their corresponding books, provide very well-written accounts of the processes that resulted in generations of modern humans and the distribution of human populations around the world.

Such a trip will take us back around four million years, back to when the most "advanced" species, in evolutionary terms, were the apes. At this time, certain apes (that today have been classified as belonging to the genus *Australopithecus*) have acquired the ability to stand on two feet. This transition into a standing, or two-footed, life is considered a major breakthrough and is accompanied by a quite important domino effect of changes initiated by the alternate use of the front feet, now hands, to handle and eventually manipulate objects. [5] We should not forget that human civilization is intrinsically linked to the manufacturing of certain tools.

The first species that has been classified as belonging in the genus *Homo* (the same as today's modern humans) appeared two million years ago. Species of the *Homo* genus had larger brains, an indirect consequence of standing on two feet, and, occasionally, a remarkable ability to make, hold, and use primitive objects. This ability progressively improved.

The earliest *Homo* that could be classified as human, or *Homo sapiens* , appeared around 100,000 to 200,000 years ago. Consistent with this view, which represents our current understanding regarding our evolutionary

history, we are descendants of *Australopithecus* through several intermediate steps of speciation. How do we view human speciation? Until recently, gradual changes in pre-existing species were thought to play a major role in the onset of a new species; such notions were progressively abolished and consecutive speciation events are considered to be the principle mechanism of human evolution. In other words, a subpopulation of one species was becoming isolated and was then giving rise to the derivative species. This isolation can be, for example, geographical or reproductive, and is not necessarily absolute and firm, or by speaking with qualitative terms " black and white," or genetically by being able to breed or not able to breed with other individuals outside the population. Reduced efficiency in the interbreeding between individuals of such isolated populations usually may be sufficient to attain isolation. So, if offspring numbers are reduced by 50 or 60%, then this may be sufficient to result, in evolutionary terms, in the generation of isolated subpopulations and the onset of a new species from a pre-existing one at some time.

Naturally, these evolutionarily related species may co-exist for extended periods of time. This was the case for certain populations of the genus *Australopithecus* and populations of the genus *Homo* around two million years ago, or the Neanderthals and the modern humans until 30,000 years ago. However, one species in the end dominates and the other species eventually disappears. This is the case with modern humans, or *Homo sapiens;* their appearance about 200,000 years ago resulted in the extinction of all other related species, including the Neanderthals, that today we may call archaic humans.

Our closest relative today is the chimpanzee. It is estimated that our common evolutionary ancestor lived about six million years ago, at a time when a population of this primitive ape split in two, one leading to chimpanzees and the other to modern humans. All intermediate species have disappeared, with Neanderthals being the closest archaic human that existed with us chronologically, until about 30,000 years ago. So, for 100,000 years or more, humans and Neanderthals co-existed. At the beginning, the former were represented only by a tiny population that was living in Africa, while the latter were more widely spread. Progressively, though, the number of humans increased, and that of Neanderthals

decreased, and by 30,000 years ago, only humans could be found—and we soon dominated the whole globe.

Until recently, and by data based predominantly in the fossil records, anthropologists thought each major population of modern humans was derived from a distinct species of archaic humans that lived in the corresponding geographical area. Consistent with this notion, Asians descend from *Homo erectus,* since the latter was living predominantly in Asia; Europeans come from the Neanderthals that lived in Europe; and Africans from other archaic forms of *Homo sapiens* . According to this model, which is called multiregionalism, it is the *Homo erectus* that principally migrated out of Africa as early as two million years ago, and modern humans emerged throughout where archaic humans lived (Figure 1).

The multiregionalism theory, while it still has several proponents, progressively has been replaced by the "out-of-Africa" model. [6] (Figure 1 .) This theory, which currently represents the most widely accepted view on human evolution, posits that modern humans, namely *Homo sapiens* , evolved quite recently, about 200,000 years ago in Africa, and subsequently migrated throughout the world. The first major attempt for human migration (we think) occurred around 100,000 years ago and continued repeatedly after that. Whenever populations of *Homo sapiens* encountered a population of archaic humans, the former replaced the latter, with Neanderthals being the last archaic humans replaced by modern humans in Europe, around 30,000 ago, as evidenced by the age of the most recent findings.

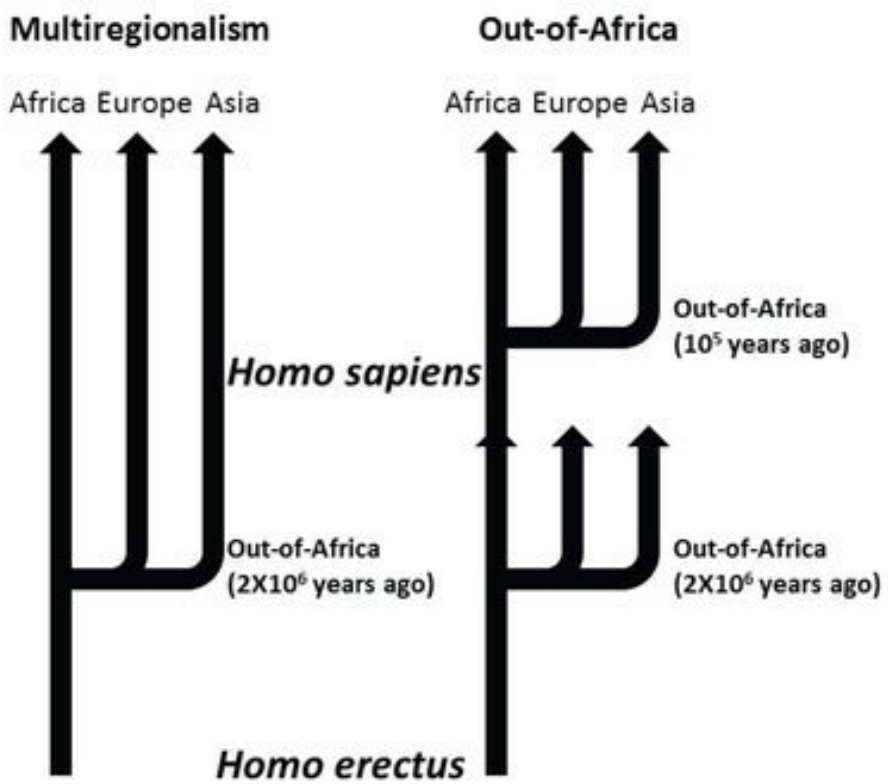

Figure 1 . Diagrammatical depiction of the multiregionalism and Out-of-Africa theories

Neanderthals caused a lot of debate regarding their evolution. It has been proposed that they represent a different species, namely *Homo neanderthalensis,* or a subspecies within the human species named *Homo sapiens neanderthalensis* . We know that, although with limited efficiency, Neanderthals could interbreed with modern humans and exchange genetic material. They had also developed quite earlier than modern humans, around 500,000 years ago, and lived in Europe and Southwestern Asia until their extinction. Several theories have been proposed regarding the disappearance of the Neanderthals, such as weather-related explanations, shortage of food, or even Creutzfeldt–Jakob (mad-cow) disease associated with the fact that they may have been practicing cannibalism; however, the true causes remain elusive.

3.1. Humans Around the World Are More Similar Than They Are Different

It is estimated that the first population of *Homo sapiens* , around 200,000 years ago, consisted of about 30,000 individuals who lived in Eastern Africa. Indicative of the fact that all modern humans share a recent common ancestor is that, at the genetic level, humans show little geographic variation, as compared to other species. Various approaches have been applied to show the degree of genetic variation. A simple approach is the following:

In a given population and for a gene at which two versions (alleles) exist (*A* and *a,* respectively), heterozygosity (H) corresponds to $H=1-(p^2+q^2)$ and reflects the possibility to get the two different alleles together. Now, if more than a single population exists, then genetic variation $G_{st} = (H_T - H_S)/H_T$. In this case, S is a subpopulation while T is the total population. By taking a closer look at this equation, we'll see that values for G_{ST} range between 1 and 0 for the cases when two populations show completely different or identical frequencies in the alleles present. It has been calculated that among different human populations, G_{ST} values are relatively low, at the range of 0.07, while in other species it is generally higher, such as 0.12 for mice and 0.67 for animals such as Kangaroo rats. In an analogous approach, it has been calculated that in humans about 85% of genetic variation occurs within groups and only 15% of variation between groups. Thus, no matter what differences can be identified, humans from different populations are more similar among each other than they are different. This is quite important in order to place in the correct perspective the differences we will discuss later regarding people who live in different geographical locations and belong to different populations. On the other hand, elephants in Western and Eastern Africa display genetic variation of about 40%. The cut-off for subspecies is considered 25–30%. Thus, these elephants can be considered as different sub-species, but not the humans that belong to different "races." Humans are quite similar genetically and not sufficiently isolated, since the time of their relatively recent development. In that view, a difference of 15% in humans between groups is small. The question, of course, is in what sense we can define "big" and

"small" in these issues, and whether 15% can make a difference. We have to consider that, as we'll see in subsequent chapters, certain polymorphisms at specific genes result in differences in activity at the range of 10–20%. These differences alone, assuming that they are the only differences among the individuals, are considered sufficient to cause a predisposition against certain behaviors and, in the widest sense, phenotypes. Furthermore, we also need to consider that such behavioral and other traits may usually "go together" in different population groups. [7] In that sense, we frequently see instead of a single trait, a set of traits that co-exist in different populations. Furthermore, these traits occasionally exhibit a complementary—which makes the archetype Western-like and Eastern-like behaviors, and eventually cultural norms, even more robust and distinct.

As an example of a non-behavioral trait (at least formally speaking, since it may be intimately linked to dairy production and consumption in Japan), we can mention that Japanese are, in their majority, lactase deficient. They frequently also have epicanthic folds. So, these two characteristics usually go together. Assuming that these two traits (lactase deficiency and epicanthic fold) were related to behavioral patterns, and when they interacted or were combined they could result in the onset of more potent (and occasionally different) characteristics, then we could understand that what we record in behavioral terms is unavoidably the result of certain synergies. Finally, by referring to populations in view of historical time, and not just the time that a behavioral experiment lasts or even the life of a human individual lasts, we may postulate that these effects will be cumulative and likely multiply progressively in the generations of people.

3.2. The Contribution of Mitochondrial DNA-related Studies

For our understanding of the human origins and the geographical distribution of people around the world, mitochondrial DNA analyses played a pivotal role. As already mentioned, mitochondrial DNA, since it is transmitted almost exclusively from mother to daughter, is particularly useful in tracing maternal lineages. Furthermore, from the degree of variation, we may calculate the number of generations, and thus obtain clues regarding the time that has passed. In that sense, it may function as an

evolutionary clock. In order to understand this, we have to consider the following: In each generation, mothers transmit their mitochondrial DNA intact to their daughters. Occasionally, mutations may occur, and two sisters, for example, who lived a few generations ago, may not have identical mitochondrial DNA. In that case, we may trace the mutation in the offspring and conclude from which one of the two sisters a given offspring is related. Furthermore, from the magnitude or the degree of the differences in the mitochondrial DNA sequences, we may estimate how much time, or how many generations, have passed from the time that the two sisters were alive.

Today, a certain number of mitochondrial DNA types have been identified in the living population through studies involving individuals from various continents and several ethnic groups that correspond to specific mitochondrial DNA haplotypes. [8] Analysis of the differences between these haplotypes allowed us to model the history of these mitochondrial DNAs, and thus, go back in time and trace back our female ancestors who gave us our specific type of mitochondrial DNA. As we go back in time, we can predict that the number of the corresponding haplotypes decreases, until we reach a point that a single mitochondrial DNA haplotype existed in a female who gave her DNA to all living humans. This particular woman who carried this predicted haplotype, and who is apparently our great-great…great grand-mother, we believe lived in Africa about 200,000 years. She has been called by various lyrical names, such as our “Mitochondrial” or “Black” Eve. Naturally, this Eve was not the only human female who was alive at the time. She likely had sisters and stepsisters, cousins and “friends.” However, she was the only one who established the mitochondrial DNA lineage that persists today, while all other females’ mitochondrial DNA disappeared at a certain time of human evolutionary history. Analogous calculations have also been made for the Y chromosome that point to an Adam, and are in general agreement with the results obtained for Eve. Of course, most likely those individuals that we named Adam and Eve did not produce offspring together, and probably they didn’t even live during the same time. However, their DNA lineages persisted through history .

3.3. Archaic Humans: The Neanderthals

Based on those and various current analogous calculations, which also take into consideration the divergence of chromosomal DNA, we believe that "Adam and Eve" lived among 20,000–30,000 individuals who constituted the first population of modern humans, about 150,000–200,000 years ago. This population of modern humans, of course, was not completely isolated genetically. They exchanged DNA with other archaic humans. However, whenever they encountered populations of other archaic humans, the latter eventually regressed and the new species of modern humans predominated. Recent analyses indicate that Neanderthal DNA is actually present in the genome of modern humans, confirming that gene flow between them occurred (Green et al., 2010). What is probably more interesting is that when Neanderthal DNA was compared to the DNA from individuals that belong to various ethnic groups, it was found that it was more similar to that of Europeans and Asians than Africans. Strikingly, the Neanderthals are as close to the French as to the Chinese and Papuans, despite the fact that Neanderthals were found only in Europe.

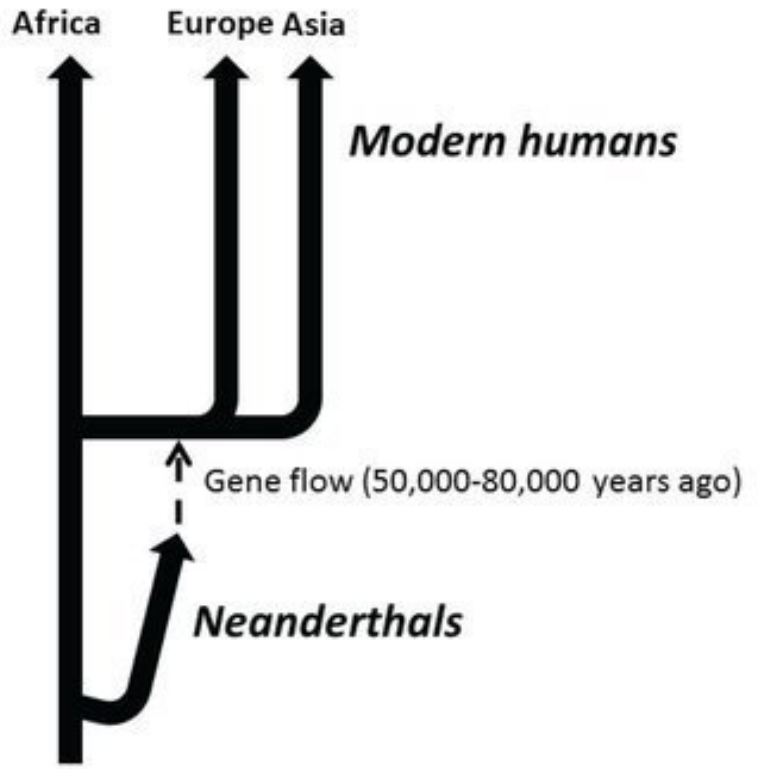

Figure 2 . Gene flow between Neanderthalsand modern humans .

Quantitatively speaking, it is estimated that between 1 and 4% of the genome of Eurasians is derived from Neanderthals. Thus, gene flow between modern humans and Neanderthals occurred before the former diverged into Papuans, Chinese, and Europeans. The likely geographic location for this interbreeding and gene flow is the Middle East, where Neanderthals co-existed with modern humans until their extinction, about 30,000 years ago. Interestingly, this gene flow was not bidirectional, since it is only the DNA of the resident population, that of the Neanderthals, that was detected in the DNA of modern humans, and not the opposite (Figure 2). The evolutionary ancestor of the Neanderthals is likely to be the species *Homo heidelbergensis,* which lived in Europe from 700,000 to 200,000 years ago. So it appears that one evolutionary line in Africa resulted in the present-day humans, while the other, in Europe, to the Neanderthals.

Besides Neanderthals, other species of archaic humans also existed, such as the *Homo floresiensis,* which lived in Asia (Indonesia). This species went extinct very recently, about 17,000 years ago. So, from roughly 100,000 years ago until that time, *Homo floresiensis* co-existed with humans. This species possessed a remarkably small body and brain size, as compared to modern humans, with features that are proposed to evolve due to the limited resources of Indonesia. This species, or its evolutionary ancestors, likely arrived at the island by sea in bamboo rafts 100,000 years ago (or much earlier than that, in case an ancestral species migrated), and remained there until their recent extinction.

3.4. Modern Humans Migrate Out of Africa

Initially, modern humans were restricted to Eastern Africa, but from around 10,000 years ago, they have colonized all continents. During their history, they replaced all other archaic humans, until about 30,000 years ago, from which the most recent evidence for the presence of Neanderthals has been recorded (with the exception of *Homo floresiensis* in Indonesia, which existed until 17,000 ago, at least). All major events of human evolution have occurred in Africa, which is the geographical source of almost all genetic variation that exists today.

If we test genetic heterogeneity outside Africa, we'll realize that it is much lower than that within Africa. Interestingly, it has been noted that genetic diversity is decreasing with increasing distance from Africa, with two major population bottlenecks having occurred that contributed to this loss of diversity (Amos & Hoffman, 2009): one around Africa and another around the Bering Strait. During these bottlenecks, genetic variation decreased considerably because only a fraction of the genetic heterogeneity passed into the new population. Thus, we assume that the first human populations, while still in Africa, acquired a certain degree of genetic heterogeneity and then migrated out of Africa, and not the opposite, according to which heterogeneity has been generated out of Africa (Figure 3). In the resulting populations, genetic variation progressively decreased over time and distance. Therefore, the new populations that were established in different geographic locations possessed only a subset of the available genetic polymorphisms that were generated in Africa.

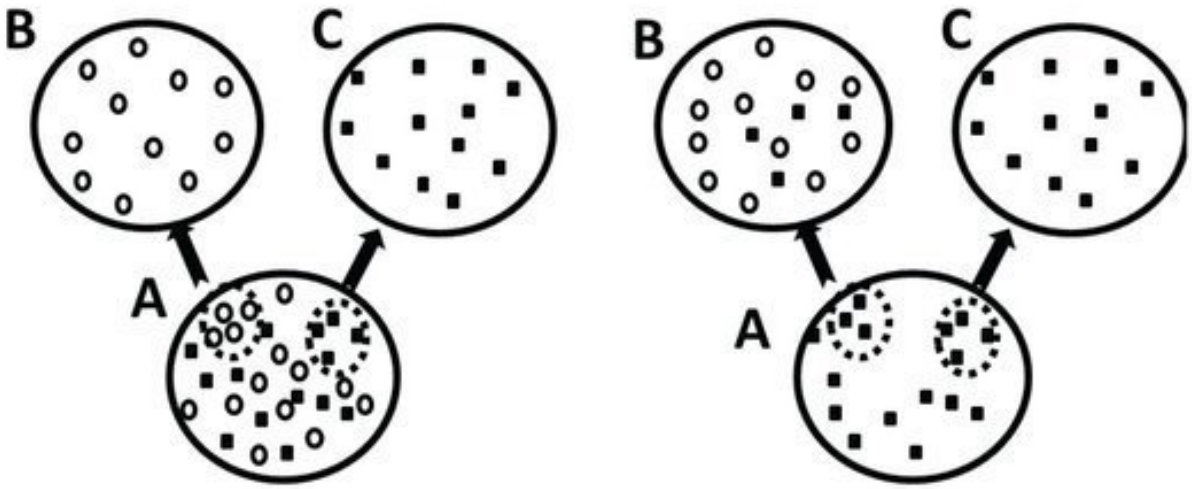

Figure 3 . People in Africa have first acquired genetic heterogeneity and then moved outside Africa (left), from area A to areas B and C. Thus, both circle and square genetic characteristics of B and C populations, respectively, are represented in A. In the diagram in the right panel, the genetic characteristic "circle" that predominates, appeared after the migration of people and therefore is absent from the originating population A. However, square characteristics are still there.

Among the older evidence indicating the migration of modern humans into other territories outside Africa are the remains found at the Es Skhul Cave, located in today's Israel about 20 km south of Haifa. Around 100,000 years ago, other archaic humans were also present in this region, such as the Neanderthals, with whom modern humans, as we said, interacted. Interestingly, between 80,000 years ago and 45,000 years ago, evidence for the presence of modern humans in the Skhul area is not available, which probably suggests that the Skhul humans retreated back to Africa from where they came from or they went extinct. Probably, the presence of Neanderthals at the time prohibited their attempts for expansion into other areas and, thus, they remained confined to Africa, which by 100,000 BC had been colonized in its entirety.

Comparisons in the anatomy of these Skhul samples and contemporary Neanderthal samples suggest that various behavioral differences had already emerged between these two hominid populations. A significant shift in human manipulative behaviors was associated with the earliest stages of evolution of the modern humans (Niewoehner, 2001).

Sometime around 80,000–65,000 years ago, humans started spreading across the world. Each time a migration wave occurred, a geographical area was occupied by people that had a distinct set of genetic features. Most likely, this set of features was random and reflected the genes and alleles that were present in the group of people that originally inhabited this area. Whenever a population was established in location A and then a subpopulation was migrating to location B, and subsequently to C, the final population had alleles present in the originating population, but the frequencies were often different. The latter difference is usually due to selection of specific alleles in the new environment, and is also due to the genetic drift and founder effects, since the group of people that migrated was not representative of the population they originated from. From this kind of data and appropriate analyses, we can calculate the route of these migratory events, the time periods involved, and the genetic relationships between populations.

A major migration wave around that time occurred via the Horn of Africa and involved the dispersal of humans to the Arabian Peninsula, towards

coastal areas of Asia. Until around 65,000 years ago, they had successfully colonized Australia. According to an interesting, very recent finding from a DNA analysis of hair of an Aboriginal man from Western Australia, the colonization of Australia occurred quite early and took place even prior to the separation of European and Asian populations (Rasmussen et al., 2011).

The similarity between Indians (from India) and Europeans, as regards their "Caucasoid" features, traces its origins to the similarities of the Indians with the groups of people that originally left Africa during this migration event. The reasons why the humans at this time preferred this route for the exodus from Africa, as compared to the alternative and straighter route that could involve spreading through the Middle East, are unclear. Probably the presence of Neanderthals in this area represented a definite obstacle for their trip. In addition, geographical reasons may also account for this preference. For example, the sea levels of the Red Sea were considerably lower than those today, which might have facilitated their travel through that route. Genetic evidence, however, is clear. Mitochondrial DNA analyses implies that the haplotypes of human populations in these areas that have been colonized during the first colonization events and involved southern Arabia, India, and Asia are not present in populations from the Middle East. Naturally, these haplotypes are present in African populations. If the route of this migration was through the Middle East, we would have expected to see their genetic fingerprints in the Middle Easterners. Thus, we conclude that the Middle East was not part of their travel at that time.

While at first the modern humans were concentrated in the coastal areas of Asia, eventually they started spreading north, and by about 40,000 years ago, they occupied the interior of Southeastern Asia, while by about 25,000 years ago, they reached and colonized areas around modern-day Beijing. Of course, the genetic composition of the people that occupied Asia was far from being considered stable over time. Technological progresses and, importantly, the establishment of agriculture between 7,000 and 6,000 years ago around Yellow and Yangtze Rivers, led to the rapid expansion of Northern Chinese populations and their intermixing with adjacently located populations. Vice versa, the repeated conquest of China by tribes from the

North, such as the Huns and the Mongols, also contributed to the increased genetic complexity of the people that occupied Asia.

The colonization of Japan is likely to have occurred through two different waves of migration. The first wave, around 30,000 years ago, was likely from people north of Australia and Southeastern Asia, who crossed into Japan by a land bridge that existed until 12,000 years ago. These people, who are called Jomonese, were cut off from the Asian mainland for more than 10,000 years and were mostly hunters and gatherers. Around 2,300 years ago, another group of people called the Yayoi entered Japan from the Korean peninsula, bringing with them rice, agriculture, and metal tools. These two major populations that occupied Japan, the Jomonese and the Yayoi, eventually intermixed, and the latter population predominated over the former .

Modern humans re-entered the Middle East from Northeast Africa around 45,000 years ago. Neanderthals who were present there at that time progressively disappeared, and modern humans were the only occupants of the area. Around 40,000 years ago, they reached and colonized Europe from the Middle East, either via Greece and the Balkans or via the Black Sea basin and the Ukrainian plains. This is supported by the fact that mitochondrial haplotypes in Europeans are mostly the derivatives of the mitochondrial haplotypes from individuals from the Middle East.

The colonization of Europe has an interesting twist. The first migration wave towards Europe, which eventually resulted in the progressive disappearance of the Neanderthals between 40,000 and 30,000 years ago, consisted of modern humans that culturally, although more advanced than the other archaic humans, were still hunters and gatherers, thus relying on the same resources for their survival as the Neanderthals. While at this time modern humans occupied virtually all Europe, the Ice Age that was in its peak around 20,000 and 16,000 years ago pushed people towards the warmer areas of Europe, close to the Mediterranean and north of the Black Sea. This retreat into the southern territories lasted until around 13,000 years ago, when the Ice Age was gone and people, assisted by the gradual temperature increases, the melting of the glaciers, and the expansion of

forests, moved back again into Northern Europe. Those people are, at least in part, the ancestors of modern Europeans.

The other major part of the genetic pool of modern Europeans traces its roots from another major migration wave, originating again from the south and likely through the Middle East. Around 10,000 years ago, a major revolution took place in the Middle East involving the invention of agriculture. Interestingly, between 10,000 and 4,000 years ago, the development of agriculture had occurred in many different societies all over the world, from the Middle East to China, to Africa and to the American continent. This development had dramatic consequences on the lives of the people and the progress of civilization. Larger cities were built, societies demanded a more sophisticated mode of organization, and people were producing more than what they needed in order to survive. So they had time for other activities, as well. In addition, a considerable growth in population occurred that caused the need for geographical expansion.

It is likely that, following the invention of agriculture, whole populations from the Middle East were already practicing it, as opposed to single individuals who could have transmitted this knowledge, moving north and then west into Europe, in coastal areas or areas close to rivers at which people could establish societies that were based on agriculture. As early as 9,000 years ago, according to the archeological evidence, farming was practiced efficiently around Athens and progressively spread to other coastal areas west of Greece. It is likely that the spread of agriculture was not due to the immigration of individual people who knew how to practice it and that taught the farming practices to the locals. It is rather likely that the migration of populations of farmers from the Middle East towards Europe took place at this time. Those people intermixed with local people whenever they encountered them, absorbing them. The genetic evidence is consistent with this hypothesis, since it shows that a genetic gradient is present in Europe from south to north, with certain alleles predominating in Southern Europe, in areas that can support farming, that progressively give way to alleles that predominate in Northern Europe, where hunting and gathering represented the common practices. It is quite likely that the present heterogeneity within the various European populations, which ranges from physical characteristics and extends to certain mentalities, is

due at least in part to the genetic origins of these populations and their relations to the aforementioned migratory events.

This hypothesis regarding the genetic heterogeneity of the populations of Europe was originally proposed by Luca Cavalli-Sforza, a pioneer human geneticist and biological anthropologist, and caused many controversies until its acceptance (Cavalli-Sforza, 2001; Cavalli-Sforza & Cavalli-Sforza, 1996). Today, according to the results of genetic studies at which Cavalli-Sforza's lab played the major role and involved studying the variation in Y chromosome of European individuals, we believe that following the original colonization of Europe, which accounts today for about 10% of the genetic pool, the major genetic constituent originates from the continuous expansions and retreats of people from the Middle East during the Ice Age. The final migration event, during the agricultural period, represents about 20% of the variation of Y chromosome and mitochondrial diversity and is due to the massive arrival of the farmers from the Middle East. Of course, these subpopulations of Europeans were never isolated, but continuous and extensive intermixing always has occurred. Thus, it is not possible to identify individuals that trace their origins exclusively to either the farmers or the hunters of the pre-agricultural period. Even in the Basque population, which is considered the direct descendants of prehistoric modern humans, alleles from the Middle Eastern farmers can be traced.

From that time until today, people from other continents are continuously entering Europe, leaving their genetic fingerprints. The Huns, for example, were nomadic people of Asian origin who invaded Europe around the fourth century, reaching France and Northern Greece. The origin of Huns in Asia is vague, but it is thought that they can be traced to the Xiongnu people in Western China, who had been defeated by the Han dynasty in the first century before moving towards West. Today, several people and ethnic groups claim their association with the Huns, such as the Hungarians, who in their national anthem describe themselves as "blood of Bendegúz," the father of Attila, the Huns' glorious king. The Turks are also thought to be related to the Xiongnu people, starting their migration from areas of North China and Mongolia towards present-day Turkey. This migration was initiated around the sixth century and lasted until around the eleventh century. Today's Turkish people can trace their origins to those Turks, but

also to people occupying these areas at the time of their invasion, such as people of Greek and later Byzantine descent.

Migration into Europe during the latter historical periods was not only due to forced invasions and eventual interbreeding with the local populations, but also the result of immigration in order to satisfy economical and other demands of the people involved. France, for example, especially during the twentieth century, hosted several immigrants, not only from other European countries but also from Northern Africa, at a period at which the Industrial Revolution generated the need of increased manpower to work in the developing industry. Even when these purely economic needs ceased to occur, the immigrants stayed, since they had adopted the life and culture of France and the other countries that received them. A similar wave of immigration is currently underway in Europe from Asia and Africa, which is empowered not only by economical but also by other political demands, as well as from the Far East, such as from China. The latter usually do not arrive in Europe as typical labor power, but rather as traders or skilled workers in scientific and technological disciplines, and it is anticipated they will eventually assimilate into the local societies and populations.

The migration into the Americas started around 20,000 ago from people originating from Eastern and Central Asia. They entered the American continent from the north and then started moving south until they established populations on the whole continent. It has also been proposed that European people may have crossed the Atlantic, reaching South America first before moving north. Settlements of Vikings may have also been established around the tenth century in North America, but it is rather unlikely that they endured as permanent colonies.

Those migration waves established the Native American populations that occupied the Americas until the sixteenth century and gave rise to significant civilizations, such as the Mayas and the Aztecs in modern-day Mexico and the Incas in Peru. The (re-)discovery of America by Columbus initiated a second, massive wave of colonization by Europeans and Africans (as their slaves, initially) that continues today. Immigration from all over the world, including Asia, during the twentieth century also continues into

the present day. The European colonization of South America resulted from Spanish and Portuguese migrants, who brought with them more slaves from Africa than their Northern and Western European counterparts did who settled in North America. Interbreeding between the European and African people in America was originally much stronger in Central and South America than it had been in North America. Following the European colonization, local populations in America were either eradicated or absorbed, with only a few and limited subpopulations—or, even more precisely, groups of people—retaining their ancestral identity culturally and, to an even smaller degree, genetically.

Collectively, with these aforementioned processes, the whole globe has been colonized by certain groups of people that eventually became specific and relatively well-defined populations. These populations carried alleles at frequencies that reflected in their rates, and occasionally in their identities and composition, the alleles of the original populations that at the very first instance moved out of Africa. None of these populations ever lived in complete isolation for prolonged periods, as supported by the cultural and, probably even more importantly, the genetic findings. A continuous flow of genes always occurred and is still ongoing at variable rates and directions between the various populations. Occasionally, this is related to certain socio-economical conditions that affected (and reflected to) human history. Furthermore, the frequency of these alleles in the various human populations changed and continues to evolve over time by phenomena involving genetic drift and selective pressure. The variation of human populations, as we witness it today, is due to the set of alleles that predominate each of these populations, and ranges from genes affecting physical characteristics and likely behavioral tendencies as well. In turn, the latter affect the development of specific human cultures and societal norms.

Therefore, the current distribution of people around the world is the cumulative result of all these great, and occasionally massive, migrations we have described. Always, the common denominator is that a group of people of a variable size that is a subset (fraction) of the originating population was moving into another territory. In general, if the size of the population of the people that migrated is small or the selective pressure in

the new environment is strong, then the divergence of the new population from the originating one is high.

On their way, these people frequently interacted genetically with other people of the local populations. This interaction, in the form of minor or major genetic exchanges, also occurred at a varying degree in the final destination as well, in the territory at which they migrated and settled. In all cases, however, the people that have migrated were not representative genetically of the originating people. It was only a subset of the genetic traits that were carried with the people and, in general, the smaller the group, the less representative it was of the originating population. Otherwise, we would have expected all non-Africans to be more like Africans, and since at some extent we are all Africans, we would expect all non-Africans to have more similarities among them. In other words, non-African populations should have been more uniform, while differences between at least the non-African populations should have been kept at a minimum. What actually has happened, though, is that these founder people who relocated into the new territory carried with them specific alleles. If, let's say, their ratio of a given allele was 1:10,000 in the originating population, but during a migration happened to be represented even once in the 1,000 people that migrated, then its ratio instantly increased by a magnitude of 10 (1:1,000 vs. 1:10,000). In that case, this allele is enriched in the migrating subpopulation, and the trait associated with it is more common in the migrating than the originating population. And this enrichment happened without any selective pressure, meaning that by having it or not in the new territory, no difference was made for the individuals bearing it. Of course, as mentioned earlier, the frequency of this allele is not going to remain stable over time and generations, but it will change eventually, depending on the selection pressures in the new environment, the genetic frequencies of the corresponding alleles in the "receiving" population, as well as the genetic drift .

We emphasize again the fact that all these notions should not be viewed as treating African or other originating populations as homogenous. This is an idea that is distal from reality, since in Africa several distinct subpopulations can be identified. Therefore, the divergence between the migrating and the originating populations increases even more, depending

on the specific African subpopulation that has initiated the corresponding migration wave.

These phenomena, of course, occur not only with the alleles that are related to physical traits, but also with those linked to diseases, as well as to any other characteristics, including the behavioral ones, that may have a genetic component or constituent. Sometimes, these specific characteristics are associated with an advantage that can be more pronounced in the new location, and thus, to increase even more in frequency over time. Alternatively, they may be related to the acquisition of a disadvantage, and thus exhibit a tendency for stabilization or reduction in their frequency. Take again the skin color as an example. The alleles that control how dark the skin color is are already there, in the originating population in Africa. An evidence for this is the high variability in the skin color intensity today in different African people. It is easy, however, to imagine that many thousand years ago, when people decided to migrate out of Africa, life would have been more comfortable for those colonizing Northern territories to have less-dark skin color, as compared to those with darker skin color and living towards the north. Not that life would be intolerable for the others. Thus, today, we can still see people occupying areas with similar distances from the equator and having considerable differences in skin color.

In a similar manner, if a gene or combination of genes were associated with “milder” behavior that was less prone to risk-taking and exploratory activities, we would rather see these people being more comfortable with agricultural activities, as compared to hunting and gathering food, which represent activities with higher risk. This increased risk may refer to both the uncertainty in the satisfaction of the nutritional demands and to the fact that occasionally it may subject individuals to life-threatening or dangerous conditions. And, as regards agriculture vs. hunting and gathering, things get even more complicated if we take into consideration additional phenomena and patterns that must emerge, such as the collectivistic behavior that appears to be an important adjuvant for the development of agricultural societies. Obviously, for the operation of activities such as farming, the intuition is not sufficient. It has to be accompanied by some empirical knowledge of how to do it, being in an area at which the climate and the

soil permit agriculture and, naturally, not being in the critical proximity with neighbors that sooner or later will force the relocation. That some of us prefer fishing and hunting (yes, they both frequently go together!) over gardening and farming as hobbies may reflect, to some extent, our genetic constitution. While hunting is related to immense action, short-term planning, and intuition, farming is associated with patience and long-term planning. While the first is mostly an individual's activity, the latter is usually collective and is highly dependent on the context.

4. The Rise of Personal Genomics

Depending on the specific scientific discipline according to which people attempt to interpret large-scale choices and decisions, some may recognize the climate, the geophysical characteristics, or even the presence of extraordinary persons within specific populations as the primary reasons that causatively shaped those decisions. Even coincidence may have played its role in the outcome of certain events and historical fates. Imagine, for example, how different the present world would have been if Alexander the Great didn't die at the age of 33. [9] Or if a fire did not destroy all but one prototype in Oldsmobile's manufacturing facility, sparing only the one that resembled the relatively cheap cars that targeted the average American and which shaped Oldsmobile's future commercial directions. [10] In the first case, we may had seen Greek as the most common language in the present world, while in the second case, we may had considered Oldsmobile as a premium manufacturer of luxury cars, leaving more space to other popular automobile makers.

I think, however, that among all these parameters, the presence of some genetic predisposition also played its role in the fate and outcome of history, particularly in the cases that human choices—direct or indirect and active or passive—were made. And this effect, even if it is seen as minimal when viewed during a certain chronological instance or when evaluated and assessed in a given snapshot of human history, its consequences were magnified and multiplied at extended historical periods and studied in the context of large human populations.

Thus, the various different groups of people, from the time they reached a new location and onwards, are starting their specific history by already having different tendencies, disease characteristics, and other traits that are

distinct from the population they came from. In other words, they are unique to some extent at their capacities, not just as independent individuals or the sum of a certain number of individuals, but rather as a whole that constitutes a dynamic group and entity. And these differences become even more pronounced when we look and compare different populations that, although they came from the same pool or originating population, the fact that they correspond to different major migration events argues in favor of their increased divergence. As an example, we can view Asians and Europeans, or Easterners and Westerners, that both correspond to populations that originated from Africa (and chronologically are distal by as much as 30,000–40,000 years). (Figure 4 .)

Figure 4 . Around 80,000 years ago, people from the Horn of Africa migrated towards the Arabian Peninsula and coastalAsia. Around 45,000 years ago they colonized Europe.

Although they were coming from the same area, they carried a different set of genes with them that defined their whole existence. It could have been that this difference is because the founding (migrating) people were genetically different in these two cases. Maybe different selective pressures were also applied during their travels and settlement that shaped differentially the final populations, or even more likely a combination of both.

Notwithstanding the details of this continuous—and actually never-ending process, as we can evidence it today—the fact of the matter is that in different populations, that largely correspond to different geographic locations, the various genetic alleles exhibit different frequencies. If we project this at the level of a single individual, we can extract conclusions regarding the genetic ancestors of this person and his or her ethnic identity. The latter does not work in the sense of attributing that person a single ethnic origin, but rather by determining his similarities and differences from various different ethnic populations .

Indeed, there are many genetic service companies that operate today where one can submit a DNA sample, in the form of a saliva wash, and get results on the composition of his genetic markers and how common or uncommon they are in the various ethnic groups for which such scientific data are publicly available. Specifically, one can get a report at which the percentile of his African, Asian, or European DNA composition has been calculated. With this information, in association with global data on DNA allelic frequencies that are available, he can get an idea regarding the specific populations that are more similar to him, [11] or with which ethnic populations a better "match" exists. Not surprisingly, by such analyses we —as Westerners—identify Eastern polymorphisms in our genome and vice versa. What we expect, though, is that people of European ancestry will have polymorphisms that are more "Western" in their genome. This is an undoubted proof that our genetic fingerprint or signature offers evidence regarding our genetic history, our ancestors, and eventually our roots and origin.

As we have mentioned explicitly at the beginning of this book, the commercial "value" of studying and analyzing genetic polymorphisms is not only limited to their inherent property as genetic markers that is useful in order to trace gene flow and to identify genetic ancestors. Of particular significance is also their use as the actual determinants of variation when their variability is translated to different properties. Numerous genetic studies attempt to link variations in the DNA with variability in physical characteristics, predisposition to diseases, and behavioral patterns. Based on these types of data, another service that the DNA-testing companies can offer is that they calculate the probability of getting sick from specific

diseases. In order to do this, they identify the presence of specific markers in an individual's DNA. It has been established by several genetic studies that specific alleles in certain genetic loci are more common in patients that suffer from a particular condition. Thus, by carrying this allele, a person is more (or less) likely to get this disease as compared to the corresponding probability for a person who doesn't have it. The idea behind such service at the first instance is to practice the "know thyself" notion and satisfy the individual's curiosity at a subcellular level on his or her genetic makeup. Of even more practical value is that by knowing the most likely causes of sickness, one may be protected better by adapting accordingly his or her lifestyle and avoiding certain high-risk habits. For example, avoiding "junk" food is good for everybody, but even more imperative for someone at increased risk for atherosclerosis. The spectrum of diseases that are included in such analyses continuously increases, and ranges from heart diseases to some cases of glaucoma and are extended to various cancers such as breast and prostate cancers.

Another type of information someone can get from this analysis is related to the prediction of the response against specific drugs, such as beta blockers, warfarin, and statins. This is a type of information that is of particular value when clinicians are determining the doses of the drugs to be applied or identify effectiveness and undesirable effects.

The precision and the range of conditions that these DNA analyses will be able to predict are only expected to increase in the future. Naturally, these DNA-based approaches occasionally touch sensitive issues and warrant increased caution in their use, particularly when they attempt to answer questions extended beyond simple curiosity or, alternatively, of a clearly defined clinical value. Potential categorization of people with respect to their DNA profile is an imminent danger that reminds us of the shameful attempts associated with eugenics.

Related to these ethical issues or based on purely scientific and technical grounds are the setbacks in the genomics industry. In the summer of 2011, the UK Border Agency canceled the use of DNA testing for purposes related to the identification of the country of origin in individuals requesting asylum. [12] In that case, the home country (or ethnic origin) of an individual

could be pointed by the frequency of certain genetic markers. An analogous setback in the DNA testing industry occurred in 2010 in the U.S.A., when attempts for direct-to-consumer DNA tests had been postponed. [13]

The main arguments against the validity and the specific value of the information of the results of these tests are related to the fact that most of the diseases and traits, especially the behavioral ones, reflect the complex and collective output of many parameters at which the genetic contribution represents only a single subordinate. This is definitely true and is reminiscent of classic and ongoing debates on the "nature or nurture" contribution for the definition and shaping of various traits, including that of human personality.

For the present purposes, it is not that important to take sides on this debate and claim whether nature (the genes) or nurture (the environment, physical and social) is more important. But even by accepting that genes indeed play some role, however minimal, in the building of our behavior, I think that this is sufficient for making a considerable contribution in the outcome of certain historical decisions.

As I have mentioned earlier, in order to appreciate the actual contribution of the genes in the behavioral patterns of populations, we always have to take into consideration two important parameters: a. The *time* we refer to is historical time and, thus, it is by far larger than that of the time period of an individual person's lifespan. To that end, we need to consider that the choices made by a given group of people and at a certain time may affect profoundly the lives of the subsequent generations. In turn, individuals of subsequent generations, by making analogous choices, may establish a trend, or a norm that generates a behavioral and cultural pattern. In other words, there is a consistency in the choices. Take agriculture as an example that, as mentioned before and will also be described subsequently, is associated with the onset of collectivistic societies that likely possess a behavioral (and genetic) subordinate. When at the very beginning of farming some people benefitted from practicing it, the subsequent generations had eventually to "choose" from continuing it or to seek for alternatives. Those that were feeling comfortable being farmers could have continued from the point that this (as an advancement) was left from their

ancestors. So, they could benefit even more from that, especially those who were more efficient in practicing it. And since, at a certain degree, it was in their genes to feel comfortable with farming and living in the associated types of societies, a trend had already been established. The latter might also produce a “selective pressure” consistent to which the individuals that could operate better in such societies might also be more efficient in advancing them. Thus, in the long run, these societies could not help but become agricultural societies. A similar tendency may be applicable to various types of societal organization that are associated to the development of distinct cultural norms. The individuals, for example, with a tendency to nomadic life are more efficient in nomadic societies than those with a tendency for being settlers. Of course, those that might feel better as settlers, by taking advantage of the presumed lower competition from other settlers, could have established settlements quite efficiently. In that case, though, we may anticipate that a subpopulation has split from the original population, And this subpopulation might also possess slightly different frequencies in the corresponding alleles that are associated with this behavior. b. The *number of people* we refer to, that is, extended to the size of ethnic populations. Within that view, we anticipate the effects to be cumulative. In order to understand this, we may consider that a trend followed by many people, in large populations, is harder to change than that followed by only few, in smaller populations. Thus, cumulatively, the consequences are larger than we may originally think.

Later, we will come again to these points when we discuss the individual’s traits and how they can possibly define a population’s traits.

5. Greeks versus Chinese: The Prototype Behaviors

The fundamental notion of this book is based on the premise that two different populations, which differ in their ethnic origins and thus in their genetic "fingerprint" or identity, are likely to respond differently against the same or similar external stimuli. These differences are likely to be interpreted and reflected as different decisions through the course of their history, which practically means that even under identical conditions they will make different historical choices.

Naturally, such arguments suffer from various conceptual and methodological limitations, and they are quite vulnerable to rigorous academic criticism. For example, the statement "under identical conditions" reflects a rather experimental approach that, in real life, is practically and theoretically impossible. Thus, by experimental means such an argument cannot be proved or disproved. It's meaningless to argue that we may put the same group of people under exactly the same historical context and record their reactions. Even if this were possible, the linear course of history would have incorporated the result of the first reaction as a historical experience that unavoidably would have affected the outcome of the—chronologically—second (latter) reaction. However, with such an argument, provided all specific and general limitations have been taken into consideration, we may identify some trends. For example, the Huns can be considered as a population prone to fighting, confrontation, and war. Undoubtedly, the geographical and cultural context in which this tribe or group of people developed historically played its role in shaping their tendency toward warfare. We may anticipate that, provided this behavior is at least in part due to their genes, even if they had to live in an isolated community, such as a "peaceful" island (let's say in the Pacific), again they would have exhibited signs of this warrior behavior. In a similar manner, we

usually view Chinese as people that exhibit a tendency for stability as a society, with a certain dislike against revolutions that cause drastic and rapid changes in the social structure. At the same time, we understand ancient Greeks as people who enjoyed argument and critique while continuously attempting to pursue their personal and individual autonomy.

Our hypothesis is that these differences are not random and stochastic but are dictated—or if this is too strong an argument, they are influenced considerably—by the genes that these people carry. Therefore, what we view as a choice is rather the complex and collective outcome of the influence of the peoples' specific genes, combined with the effects of their specific environment. In turn, this makes the probability for rendering a certain choice distinct between different populations.

Let's assume that there are two hypothetical populations, named A and B, that can make a decision to take an exploratory action K or not to take this action, being the decision L. If there is actually a gene that increases the tendency to pursue the exploratory activity, and this is more frequently found in the population A, it is anticipated that these people will be more likely to take exploratory actions, while as a population to be committed to exploratory activities more frequently. And this tendency will not be expressed only once but repeatedly. Since this feature is "programmed" in the genes, then their descendants (as well as their ancestors) will be more likely to take this exploratory action than the B people. Thus, it is conceivable that A people will have a history more dense in exploratory events than the B people. It seems that a certain pattern emerges in that case that will profoundly affect the culture and civilization of the A people. By analogy, imagine a population with a higher frequency in a gene that offers a tendency for a "collectivistic" behavior. Such behavior implies that the individual is defined by its position in a certain group, and frequently the needs of this group surpass the needs of the individual. On the opposite side is the individualistic behavioral pattern, at which the focus on personal autonomy plays a major role in one's life. In that case, it is quite likely that the population with such a collectivistic gene in abundance will display a tendency toward developing a culture at which individualism is reduced or diminished. This, in turn, will cause the development of less liquid societal structures at which people maintain relatively strict positions. Furthermore,

the good of the group will be predominant while the good of an individual will play only a minor role. It is also quite likely that such societies will be larger and characterized by a type of more centralized administration that will maintain its structure more efficiently. On the other hand, the populations that have the "individualistic" gene at a higher frequency are expected to be driven by the pursuit of personal autonomy; relationships between individuals will not be stable and constant but rather transient. Furthermore, in such societies the individual's needs appear to play the major role, regardless of whether they are good or benefit the whole group.

In general, these differences do not simply affect choices such as population expansion against maintenance, attack or defense, or development of complex and hierarchical societies, but can trace their differences in the very essential notions of how the world is made and operates, what are the essential driving forces of the universe, what is the purpose of life, as well as to questions related to the pursuit of happiness and how this can be achieved.

As we will see in subsequent chapters, such a polymorphic gene with different frequencies in various populations actually does exist, and among other behavioral traits it is also associated with an elevated tendency for sensation-seeking and risk-taking. The fact that this gene is polymorphic means that certain versions of this gene are more likely to be associated with increased risk-taking than others. Depending on the exact context of the experiment that led to such conclusions, this particular gene has been linked to diverse actions ranging from the degree of pleasure that someone receives during specific thrill activities, to gambling and even drug abuse. Thus, it is quite reasonable to speculate that such genes will have a profound and pleiotropic effect capable of affecting diverse facets of life. To that end, a whole spectrum of behavioral patterns will be expected to go together in the corresponding individuals, a fact that makes the differentiation of these people even more pronounced.

Before we try to view and probably attempt to understand and explain different populations and cultures in terms of their different genetic identities, it is important to identify such elementary notions that are distinct among populations. In other words, identify differences in the

essence of distinct populations and realize that certain analogies are rather superficial and oversimplistic, despite our tendency as Westerners to view and interpret history and people by our rather naïve Western eyes. For example, the Olympic games in ancient Greece had a completely different meaning than the riding or hunting competitions of the Mongols, while the geishas in the Far East possessed quite a distinct role in Japanese society, as compared to the role of prostitutes in the society of ancient Roman, despite that, due to oversimplifications, certain analogies can be identified and occasionally exaggerated .

Such notions are expected to transcend everyday lives and also to provide the context, and the mainframe at which the whole civilization, culture, and historical decisions have been made. Then, it will be probably easier to interpret different reactions in terms of the fundamental notions of how life is viewed. In order to do this, we may identify basic differences in certain civilizations and then attempt to evaluate whether these differences can be explained by the presence of different behavioral traits, due to distinct allelic frequencies, among these populations.

Among the various civilizations that emerged throughout human history, two major lines of thought can be identified that differ considerably in the fundamental perception of how the world was viewed and explained: the Eastern and the Western view that trace back their origins in the philosophical traditions of ancient Greeks and Chinese. In turn, they are exemplified by the lines of thought condensed and initiated by Aristotle and Confucius, respectively. Throughout history, these lines of thought dominated the development of these civilizations and continue to affect and shape the lives and perceptions of modern peoples as well. Not coincidentally, these major cultures were developed by populations with relatively distinct genetic identities and allelic frequencies at various loci, which had minimal interactions until only very recently, perhaps a few hundred years ago. Thus, they had the chance to develop culturally by maintaining their “independence” to a certain degree.

Contemporary globalization has scaled down these differences, with Western thought appearing to play a more dominant role today. However, Eastern perceptions of the world, although likely better hidden as such, also

seem to affect Western thought and appear attractive to Westerners. For example, small feng shui gardens containing running water and bonsai trees frequently decorate the headquarters of multinational corporations, while McDonald's restaurants flourish in Shanghai and other major cities in the East. Cross-cultural exchanges are not limited to lifestyle trends but transcend deepest notions of our civilization with important consequences in shaping future cultures and societies. For example, Eastern-type holistic perceptions gain more and more ground in Western science and find application in medicine, ecology, and even biology. On the other hand, in the East, analytical basic science research institutes, which did not represent the stronghold of Eastern science until recently, are flourishing in Japan, representing the front of a wave that soon will involve China, Korea, and other Eastern countries .

Whether these two great people, Aristotle and Confucius, are the ones who indeed shaped the corresponding thoughts and philosophies, or if it is the specific societies that allowed them to flourish and express their ideas, thus dominating the corresponding cultures, is still under debate and represents a deep philosophical question that is initiated by our perception on how the world and history is moving along. My personal opinion favors the latter notion, that it is not Aristotle per se but rather Aristotle combined with the specific receptive population that resulted in the specific outcome we witnessed and recorded. It is likely that this represents an Eastern-like, holistic view according to which it is not the individual but rather the combination of the individual with the context of his society or group that plays the signifying role. But if the exact same Aristotle was born in ancient China, he wouldn't have been the Aristotle with the recorded magnitude of contribution to civilization. The mere presence of Aristotle in ancient Peking would not have been sufficient to turn the Chinese, as followers of logic, toward individualism and autonomy. The same applies regarding Confucius. His presence in ancient Athens would have been insufficient to turn ancient Greeks into collectivists, applying holistic perceptions of life and thought and being seekers of harmony and balance.

As an argument, I would propose that in ancient Greece, individual philosophers with more similarities to Eastern philosophies, notions, and perceptions occasionally appeared, such as Heraclitus, who introduced the

concept of constant change. This notion, in its essence, is rather Eastern, since it implies that nothing is absolute and independent of its context. Everything, according to Heraclitus, acquires its true meaning only within the frame in which it is examined, while two identical conditions cannot formally exist, since at least the context will be different. [14] Despite the teachings of Heraclitus, the line of thought that was exemplified by the Aristotelian teachings is the one that actually persisted until today, and we, being Westerners, consider ourselves his intellectual descendants.

I couldn't have explained this adequately by the more attractive and influential personality of Aristotle, but rather by the presence of one more susceptible to these ideas and minds of ancient Athenians. Vice versa, in ancient China, Ming-jia and the Mohists advocated the pursuit of truth and logic for the sake of the individual, an approach that is rather Western-like; however, their influence was not as profound as that of Confucius in their societies (Lai, 2008) .

Richard Nisbett's stimulating *The Geography of Thought* (2003) very nicely illustrates the differences in the way of thinking between Chinese and Westerners, while provides a rather psychological explanation for these differences. While the essence of Greek philosophy is to understand the fundamental meaning of the world by logic and subsequently abstraction, in Chinese philosophy of the pursuit of harmony predominates against truth. Not that a "false" argument is preferred over a true one. It's just not that important whether something is true or false. What really matters is whether it is good for the group and promotes harmonious living.

The importance of harmony is detected in various different aspects of life, not simply the everyday life, but also the myths and the legends of each culture. Take as an example how dragons are seen in the East and the West. In the East, they are considered to be wise creatures with mythical powers, are valued for their magic abilities and their beauty, and are perceived without having the inherent tendency to inflict damage or to represent evil. Contrary to that notion, in the West, dragons are fearful, evil creatures, they are particularly powerful, and occasionally they exact punishment or function as guardians of a treasure or of a sacred entity or object. That difference is not irrelevant to how different cultures see the world. In the

East, within the context of the world's harmony, people do not have to be scared of the dragons, which can co-exist harmoniously with them. People do not necessarily need to confront them, and thus feel vulnerable against them. In the West, however, in which people are demanded to dominate the world, these creatures with the supernatural powers represent a clear danger to the people, since they are uncontrollable.

Depending on the exact line of thought, the objective of harmony can be different. In Confucianism, harmony among human beings plays the predominant role, while in Taoism, harmony with nature plays an equally important role. In both cases, however, the notion of balance is considered to be essential, and thus the indicated route of choice is the "middle way." The resolution of disputes amongst Easterners takes greatly into consideration the context and attempts to satisfy both parties, frequently by compromise, while with the Greeks, logic dictates only a single truth that is derived by rationale. This truth is single and unique and does not change with the context. Correct is always correct while wrong is always wrong for Westerners. Thus, religious wars were quite uncommon in Eastern history but so common in Western history. [15] Collective decisions in the West, traditionally, either directly represented in case of democracies, or at least they expressed in the cases of societies run by a single ruler or an oligarchy, the average of individual thoughts and the needs of the group's members. Of course, disagreement between the public feeling and the ruling body frequently occurred and actually still does at various times and places; however, it was resulting in a distinct and identifiable oppression that eventually had to resolute as history continued. This "wisdom of crowds," which consists of free-willed individuals and constitutes the fundamental stone of democratic societies, is very nicely described and explained by Surowiecki (2004) in his homonymous book. In this book, though, special emphasis is given to the fact that the individuals that constitute the crowd or the group have to be independent, with minimal influence from the other members of the group. Thus, the corresponding decision is not collective, since the people are required to maintain their intellectual independence.

Consistent with these notions, Greeks advanced individualism and viewed the freedom to satisfy curiosity as means to reach the ultimate happiness, while in Chinese society, the cultivation of a collective

conscience gains a major role, and the interaction with family, friends in a harmonious natural environment is central. The quest for happiness as the ultimate purpose of life is, in the West, achieved by the advancement of individualism, while in the East by cultivating collectivism. This advancement of individualism in Western thought is quite central and can be seen in various expressions of their civilization, even in music. While Western music is polyphonic, Chinese music is monophonic. Beauty in the West is achieved by the combined result of putting together successfully different independent musical instruments playing their individual music. Individuality is not lost within the musical group; instead, the music produced by each instrument contributes to the whole result.

An analogous principle applies to medicine. Western medicine is quite analytic, trying to understand the cause of the disease and, subsequently, to intervene with that. On the opposite side of that approach is Chinese medicine, which is holistic and attempts to restore the lost balance in the body. Science did not advance greatly in ancient China because the satisfaction of curiosity was not a major issue, but technology did because it could help people and societies to overcome certain difficulties they faced and to achieve harmony. It doesn't matter for Easterners how an invention works, but rather that it works !

The advancement and domination of the Western world over the rest during recent human history is summarized by Niall Ferguson (2011) through the six "killer applications" of the West: competition, science, property, modern science, consumption, and work ethic. All of them attend quite well the legacy of the ancient Greek line of thought and are deemed responsible for the prosperity and predomination of the West. [16]

The cultural divergence of the West and the East may also explain why Chinese culture unified quite early, with societies soon organizing around a centralized government, while in the Greek civilization, the independent city-states represented the characteristic form of civil and political organization. For the latter, of course, the mountainous geography in Greece did not favor agriculture and also induced some isolation, but it is hard to attribute these great differences solely to this factor. After all, extended exchange of ideas, goods, and genes did occur in ancient Greece, which

could have facilitated the generation of a single society organized under a centralized government. Unification in Greece occurred soon after the Classical Period, during the times of Philip the Macedonian; unification continued and was profoundly extended by his son, Alexander the Great (the so-called first imperialist in global history), who reached as far as India. These periods were quite unstable, however, and did not last for more than a few generations, possibly because they were not reflecting the demands and the consensus of a society that has not succeeded in feeling unified. As soon as the strong central administration ceased to exist, dissemination of these political structures started to occur.

The notion of "field dependency" is central in Chinese culture and is in line with their agricultural tradition as well as their holistic view of life and their desire to search and rely on *relationships* rather than individual *objects and categories,* as dictated by the analytic approach of Westerners (Nisbett et al., 2003). Consistent with this view, an action or condition cannot be judged as right according to the Chinese without taking into consideration the specific context, as defined by the whole frame of relationships with other people, society, and physical environment. This notion is very nicely illustrated in the following old Chinese story, taken from Nisbett (2003):

> An old farmer had a horse that ran away and his neighbors came to commiserate with him. "Who knows what's bad or good?" he replied to them, refusing their sympathy, while indeed, a few days later the horse returned bringing a wild horse with it. Again, the neighbors came but this time to congratulate him. They received again the same reply from the old man: "Who knows what's bad or good?" Indeed, his son, after a few days, tried to ride the wild horse but broke his leg. The neighbors again came to express their sympathy for the misfortune of the old man's son and received again the typical answer from him: "Who knows what's bad or good?" Again, the village went to war some time later but the son was unable to participate because of his accident.

The story continues in the same motive, according to which the same event or condition cannot be judged as negative or positive without taking

into consideration the context in which it appears. Something cannot be good or bad as such, but rather good or bad through the specific conditions in which it is examined. This is also in line with the farmer's "seed and soil hypothesis," according to which a specific seed is good only when planted in fertile soil that frequently is appropriate for that seed exclusively. There is a specific relationship that signifies the efficiency of the outcome that, in turn, does not rely only to the identity and the properties of the specific objects. Thus, the predominant for the Easterners' concept of the whole, the notion of collectivity, gains increased significance, and its value is determined by the quality of the relationships, along with that of the individual elements. The fact that Westerners are more attracted by the specific individual objects and their particular properties offers a preference in individualism at which the value of the relationships appears second to that of the elements involved. After all, the atomic theory of matter, according to which the whole world is composed of invisible and tiny particles, is credited to the ancient Greek philosopher Democritus.

The perception of collective consciousness, which is highly esteemed by Easterners and is surpassing that of individual consciousness, has dictated the whole organization of their lives, even until today. Elements of this approach can be identified even to domains of life that are, at their essence, considered highly individualistic, such as issues related to economic success. An example is offered by the recent success of the Chinese economy that has occurred after Western practices have been incorporated in industrial production. This success, and the related to that positive projection (the Chinese giant in industrial production as usually called), is likely that it is also due to this exactly collectivistic way of thinking of the workers. And this is not a conscious decision, but an unconsciously followed norm that is followed just because this is the way things are. According to this notion, the company's productivity and well-being is dominant against that of the individual workers'. Thus, wages can be kept at the minimum for more prolonged time periods without posing an imminent danger to the stability of their society. Characteristically, according to Ferguson (2011), the average Korean works 1,000 hours more a year than the average German! Of course, in that case, the question is for how long this can continue until Korea, China or other Eastern Asia countries abolish their competitive advantage. Economists will probably

argue that this cannot continue for long, and that such collectivistic attitudes will retreat with a buildup of a liberal capitalistic society. Eventually, it will have to give way to several independent prospective businessmen and investors who, after a certain point and as soon as the wages of the workers and overall quality of life rises above a certain threshold, will start demanding a larger percentage of the profits. Instrumental to this transformation is the ongoing globalization at which Western-like behavioral patterns and norms are readily accessible to Easterners (and vice versa, of course). As we'll discuss in subsequent chapters (12 and 13), analogous are the predictions if we focus on behavioral trends.

Other facets of this behavior, beyond the purely (if there is such a thing!) economic level, might also be related to more political issues. Drastic changes in the political systems or the ruling partys were limited in Eastern societies, as compared to those of Western societies, a trend that was also reflected by the many different nations and states within the European continent that follow the political tradition of the ancient Greek city-states. Even more striking is the frequency by which borders changed during later European history, as well as to the strong nationalistic feelings that persist even today within the European nations. Virtually all citizens of European countries feel quite distinct from the citizens of the countries they share borders with, and not infrequently, even from other citizens of their own country! In the U.S.A., along with the American identity, the "state" identity also plays a major role, which may reflect the strength of individuality. During the Roman era, that Europe and its surrounding territories were unified under a single administration does not contradict the Balkanization tendency of Westerners, since who the ruler was and who the one that has been occupied by force was remained clear throughout history. Finally, today we all witness the difficulties of the attempts toward European unification, and only a few years after the introduction of the common currency, it appears how unstable and vulnerable this still is. At the time that these words are written, a major issue in the news is whether the Euro, the common European currency, has a future in history or not.

As opposed to the Europeans, the Chinese, throughout their history, remained a largely unified society that was mostly ruled by a single administration, without strong attempts for territorial expansion. It is

conceivable that it wouldn’t be like that if the perception of the collective consciousness did not surpass that of the individual.

It has to be noted that such “collectivistic” or “individualistic” decisions are not related to a notion of right and wrong, and by no means does a rule of majority apply that may imply that the collective is wiser than the individualistic. It’s just differences between perceptions and life approaches. After all, Surowiecki (2004), in his *Wisdom of Crowds* , shows that the crowds are wise only if they have achieved the highest degree of independence, while interdependence reduces this wisdom!

So, collectively, during human history, the people who occupied and inhabited the corresponding areas developed two major lines of thought, the Western and the Eastern, with fundamental differences in the way life is viewed, explained, and eventually lived.

6. Population versus Individual Traits

The assumption that populations that have genetic pools with different allelic frequencies at certain genes—and that this can affect behavior—is based on an oversimplified extrapolation that, in turn, bears certain limitations. It is wise to keep these limitations constantly in our mind during this discussion.

The most apparent such extrapolation is due to an arbitrary, however unavoidable, jump from the individual's towards the collective population's traits. In other words, I assume that a certain trait for a given society becomes more intense if more individuals with this specific trait are present in this society. Various mathematical and computer simulation models on the behavior of individuals as members of a group as well as the effects of genes that act at the level of the group (instead of the individual) may prove the limits of this assumption. However, in order to see the magnitude of these limitations, let's attempt to see this by a more simplistic and qualitative manner. To that end, we assume that there is a polymorphic gene that can dictate an easily manifested behavior, such as aggressive behavior. We don't refer to aggressive behavior in that case to its formal psychological definition, which is associated with violence, but rather to its widest meaning, which reflects the tendency to impose a certain way of life and reactions on others and to resolve possible disputes by force and confrontation. This force can be both physical as well as psychological and intellectual. First of all, this hypothesis is oversimplistic per se, since there is not such a gene that affects behavior and controls a single trait only. As we will see in detail in the following chapters, in all cases, a single genetic polymorphism affects more than one behavioral trend, and psychologists find this quite reasonable since they view all such trends as interconnected.

In any case, let's now assume that this gene is represented in two forms, with allele A1 associated with more elevated aggression than allele A2. If A1 is more frequently present in group A, then this population contains more people hardwired for aggressive behavior than the other, the B population, at which A2 is more common .

Our simplistic assumption continues; population A has more aggressive individuals, and will also be a more aggressive population as such, as compared to the population designated as B. Taking this hypothesis one step further, we may contact a hypothetical historical experiment in which the two populations, A and B, participate. All parameters in this experiment, including environment, population size, as well as the rest of the genes—excluding genes A—of the allelic frequencies are the same. In other words, the two populations are identical except the number of the aggressive individuals they include. The experiment starts when we take the populations A and B and we put them together, offering them distinct territories in close proximity to each other. We can even limite both their food supplies in order to promote and facilitate confrontation. It is rather likely that we will soon witness a fight in which the A people will try to dominate—and possibly soon will—the B people. So, at the end of the experiment, and since all other parameters besides the A frequencies are similar, we may expect to see a single population with two distinct subpopulations, the A and B, with the former dominating the latter. Simply thinking this is quite true and well anticipated, and reflects that in simple confrontations the more likely winner is the one exhibiting the more aggressive behavior.

It is more complicated, though, when we talk about populations instead of individuals, and this is not only because the system is more complex and unpredictable, but for a number of other good reasons as well. An alternative scenario would be that following their interaction, the aggressive A people should also manifest aggressiveness not only against the B people, but also against themselves. It is conceivable that this will have to do with the share of power (or resources) in the new group. After all, they are aggressive people! In that latter case, it is not unlikely to expect that the B people will be the ones that will dominate the mixed population, since the A people will be much too preoccupied to satisfy their confrontational

instincts, while the others may be more able to dictate the terms of co-existence, thus appearing as the dominant population. This possibility becomes even more apparent if, at time 0, which signifies the initiation point of the experiment, instead of putting the two groups instantly together, we leave them alone for a certain period of historical time. In that case, it is conceivable that the civilization of Bs will be more advanced, since we may expect that massive aggressiveness is usually against collective advancement. At the end of this experiment, the independent observer, in that latter case, will record that despite that A people are more aggressive, it is the B people who have dominated the mixed population. So, at the level of populations, things may not come out the way we have anticipated as to the individuals.

Someone may argue at this point that if the successful outcome in such an experiment is measured as the degree of domination of the one population against the other, then some but not too much aggressiveness might be beneficial. Indeed, if aggressiveness is limited below the hypothetical point at which it becomes deteriorating for a given society and does not pose an obstacle to its advancement, this may be synergistic to domination. Thus, some but not too much aggressiveness may be good and a perquisite for success. Countless everyday examples, ranging from the behavior of schoolchildren among their peers, to the attitudes of various professionals, support this notion. So probably, this is a reason that robust cultures and civilizations were built and developed by populations at which the various genes we'll discuss subsequently differ in the ratios of their frequencies, but in none of the cases can we see absolute absence or presence of certain alleles. A plausible explanation for this is that the presence of the under-represented alleles is obligatory in some sense for the proper and calibrated functionality of a certain society.

We may envisage countless alternative probabilities and scenarios that result in the deviation from the result we originally anticipate. Nevertheless, and for our specific purposes, we may expect that a society with more (but not exclusively composed by) aggressive individuals will constitute a more aggressive and prone to domination society, or a group of people with many risk-takers and novelty-seekers will more frequently undertake exploratory activities and will be prone to change, and so on. What is interesting,

though, in that case is that as we will discuss, several of these tendencies are controlled by the same polymorphic markers. And even more surprising, probably, is that even those that aren't controlled by the same genes seem to go well together in the same populations!

PART 2

DISCUSSION OF SELECTED TRAITS IN RELATION TO CERTAIN POPULATIONS AND THEIR CORRESPONDING CULTURES

7. Exploratory Activity and Novelty-Seeking: The Case of Dopamine Receptor D4

Two of the earliest studies associating certain genes with a specific behavior were conducted almost 20 years ago by Hamer and co-workers (Benjamin et al., 1996) and Belmaker and co-workers (Ebstein et al., 1996) in an attempt to identify a genetic predisposition toward novelty-seeking. This trait is thought to have a certain genetic component and is associated with behavior that is impulsive, exploratory, fickle, excitable, quick-tempered, and extravagant. On the other hand, individuals who are not characterized as high-novelty-seekers are those who score lower than average in the corresponding tests and tend to be reflective, rigid, loyal, stoic, slow-tempered, and frugal. As happens with this type of study, the researchers examined the frequency of the alleles under investigation in groups of people who had been classified according to the characteristic under study, being the novelty-seeking behavior in this case.

The aforementioned genetic analyses performed by these research groups found an association of the novelty-seeking behavior with certain alleles of the gene that encodes for the dopamine receptor D4. Specifically, the novelty-seeking behavior was associated with the 7-repeat allele (see below). Not surprisingly, the results of these studies, like the vast majority of genetic association studies, should not be considered as definitive, since other investigators failed to reproduce the results (Paterson 1999); however, even though the statistics are not as strong as they should be, a certain element of truth or a trend must be there.

How does dopamine work? Dopamine neurotransmission is essential in regulating behavior, controlling, among other factors, movement, emotional

responses, and one's capacity to feel pleasure and pain. Early antipsychotic drugs acted by inhibiting the activity of dopamine, underlining the significance of this system in regulating behavior. Dopamine is a neurotransmitter that, upon binding to its corresponding receptors, including the D4 receptor, inhibits the levels of a second intracellular messenger known as cAMP. D4 receptor in particular is polymorphic, exhibiting alleles that differ in the repetition number of a certain stretch of DNA consisting of 48bp nucleotides. Thus, depending on how many times this 48bp-variable number tandem repeat (VNTR) within the D4 receptor is repeated, different alleles exist in the population. The most common allele in the general population is considered the one that has four such repeats, followed in frequency by the one with seven repeats.

How is the number of those repeats linked to the different properties the D4 alleles may exhibit? At the functional level, a difference in the activity between these alleles has been found. Specifically, these alleles are thought to differ in their ability to reduce the levels of cAMP within the cell, with the one with the seven repeats being less active than the ones with the four or two repeats. Therefore, cells, and thus individuals, bearing the 7-repeat alleles fail to have the cAMP levels efficiently reduced as compared to other individuals with more active DRD4 alleles, such as the shorter four- and tw0-repeats alleles.

In terms of the evolutionary history of the DRD4 gene, the specific potential "value" of the 7-repeat allele is also pointed out by the observation that—contrary to the other DRD4 alleles that are considered as simple, one-step, molecular derivatives of a single allele—the 7-repeat allele differs from other alleles by at least six molecular events (Wang et al., 2004; Ding et al., 2002). This indicates the operation of positive selection pressure for this allele that resulted in the increase of its frequency in human populations. Thus, individuals bearing this allele had an advantage (or in cases of group selection, the advantage occurred at the group these individuals belonged to).

7.1. DRD4 Alleles Have Different Frequencies in Different World Populations

Interestingly, different alleles of the DRD4 gene, along with a differential activity, also show quite different distribution among different populations: For the 7-repeat (novelty-seeking) allele, it was found that it was much more common in Europeans and populations of European origin, such as the Americans, as compared to Asian populations (Chang et al., 1996). Whether these differences represent the collective and cumulative result of selective pressure or they are due to founder effects related to the genetic composition of the early populations that inhabited the corresponding areas remains elusive and is actually impossible to prove or disprove with certainty. The fact, however, is that the allelic frequency of the novelty-seeking, 7-repeat allele for most of the Europeans studied, ranges between 0.06 –0.21, while the corresponding value for the South East Asians was considerably lower, approaching 0 for most of the cases (Table 1). In this table, the sum of the frequencies of the 7-repeat and 4-repeat alleles is not equal to 1 because additional, rarer alleles have also been identified in these populations. A noteworthy exception in this distribution is the corresponding frequency found in Malays that had this allele at a frequency as high as 0.17, deviating from that of their Asian neighbors and approaching or even surpassing the range of frequencies recorded for the distal Europeans.

Omitting, however, the details, we will see that Asians have in general a lower incidence of this 7-repeat allele than Europeans.

Let’s now recall the fundamental differences between the mentality and the perception of life between Easterners and Westerners, and then try to understand them in view of the characteristics that underline the personality of the novelty-seekers described earlier. In general, Westerners appear to be more independent as persons, having the concept of individuality as a fundamental element of their civilization. Their increased excitability and attraction to extravagance that are intrinsically linked to the novelty-seeking behavior, are also related to this individualism and the tendency to constantly seek for means to obtain satisfaction. The Westerners are certainly more keen explorers, as well. After all, they were the ones who actively and repeatedly attempted to meet the Easterners, and not the other way around.

Continuous exploration at all levels, including physical, geographical, and intellectual, is an undeniable feature of Western civilization. Particularly in today's Western and Westernized societies, such exploratory activities are not performed in order to satisfy needs that developed, but they emerged as an actual need that has to be satisfied.

On the other hand, Easterners appear to be more passive against life, an attitude that reflects a certain degree of stoicism and makes life within larger—and likely collectivistic—groups of people more convenient. Taking things the way they are probably reflects their belief that there is not much that one can or should do to change them. This is probably the reason that these people appear rigid against life and loyal, a fact that is also reflected historically in their relatively high political stability. Although Easterners are undeniably hardworking people, their more intrinsic motivation is probably not related to a notion of individual advancement, such as in Westerners—a notion that in turn has assisted capitalistic and individualistic societies to flourish (and, vice versa, flourished within these societies). It is instead related to a sense of loyalty against what should be done, what the regulations and the establishment dictate, and of what should be done according to what is thought to be the common and collective good, for the benefit of the society as a whole.

Table 1 *. Allelic frequencies of the 7-repeat and 4-repeat alleles of DRD4 in selected populations (adapted from Chang et al, Hum Gen 98:91, 1996)*

Population	**4-repeat allele frequency**	**7-repeat allele frequency**
Africa		
Biaka	0.76	0.14
Mbuti (Zaire)	0.83	0.16
San Bushmen	0.91	0

Falasha	0.83	0.11
Europe and		
Middle East		
Mixed European	0.57	0.21
Roman Jews	0.63	0.19
Danes	0.67	0.14
Finns	0.69	0.06
South and East		
Asia		
Chinese Han	0.76	0
Japanese	0.79	0.01
Cambodians	0.52	0
Yakut	0.83	0.04
Malay	0.42	0.17
South America		
Colombians	0.23	0.62
Ticuna	0.20	0.78
Karitiana	0.39	0.5 0

This attitude against life is also probably assisted by the frugality exhibited by the non-novelty-seekers, like the Chinese. A likely

consequence of being frugal is that no matter what your individual productivity is, a larger—in general—portion of your product may go for a common cause than return directly to you, the producer, as a profit. Therefore, it is not the individual but rather a larger sum of people, or a society, that receives such benefit, while the individuals only indirectly benefit, just by being parts and components of this society. This in turn strengthens the collectivistic behavior.

It could be argued that today's well-organized societies of the West try to cultivate (and indeed have managed to) develop an increased conscience of the common good, while they have also nurtured the concept of discipline that is a perquisite for them to operate. These all are certainly true; however, it is possible that such tendencies, instead of reflecting a holistic view of the world, are an unavoidable specific requirement for them to function and to allow individualism to develop. As opposed to this notion, the concept of rigidity and loyalty against social structures and hierarchies, that is intrinsic to Easterners, is also in good line with the behavioral characteristics and attitudes of those that are not novelty-seekers.

The increased context dependency of Easterners is in agreement with this characteristic, since they view happiness not as remote from the "whole," but rather tightly associated with it. Such an attitude is inherent in societies at which collectivism tends to surpass individualism.

Today, we can all witness that in China, in one of the fastest-growing economies of the world, the average standards of living are much lower than those in the West, and that those standards may be disproportional to contemporary Chinese productivity and economic development. Of course, it could be argued that this is mostly due to very recent political and historical reasons related to the fact that only recently has China adopted more or less typical capitalistic practices while coming from a totalitarian regime. However, even in neighboring Japan, at which the capitalistic mentality is more mature and comprehended, the collective benefit frequently prevails. Probably in that case the larger structure we refer to is not the whole population of these people. It can also be the corporation (the employer), but again the individual good gives its place to the good of something larger and greater than that of a single person. R. Nisbett, in his

Geography of Thought, offers several nice examples describing in detail these differences .

The fact that Eastern science is not, in general, considered as innovative as Western science—although it is certainly more technologically oriented—can be explained by the fact that while Westerners, by being better novelty-seekers, tend to discover and explore. These characteristics are tightly linked to the advancement of science. Advancing science in the West does not represent means to reach a specific goal but is rather due to the satisfaction of individuals' curiosity on understanding how the world functions. The fact that specific results of scientific research are frequently useful and applicable is not an integral subordinate of the investigation process but rather a desired outcome. The actual motive is to understand how the world works.

Contrary to that perception, Easterners are more prone to technological advancements that ultimately attempt to satisfy needs of society, and are not dictated by plain curiosity. "If an invention works, then it's not necessary to know how this is achieved" can be the motto of this technological advancement. Alternatively, who cares how the world works if this doesn't make our lives better? The recent investment of China in basic science doesn't contradict this approach. [17] It just shows that we may have reached a point that basic and applied science are practically indistinguishable, as well as to the fact that this may be driven by other motives related to the nation's prestige in the global scientific community.

7.2. DRD4 and Human Migrations

The comparison between Easterners and Westerners, as regards the novelty-seeking behavior, appears to be, in general, in good line with the reported data on the frequencies of the corresponding alleles, with the Eastern populations exhibiting lower frequencies of novelty-seeking alleles as compared to Western people. If, however, we look at Table 1 more carefully, we'll notice some interesting twists. We'll see that the populations from South America have very high frequencies for the 7-repeat allele, surpassing that of all other populations examined. A high novelty-seeking behavior, by the cultural standards described earlier, is not sufficient to

explain this for the South Americans, since they haven't exhibited evidence for high exploratory activity, at least as viewed according to typical Western eyes. Of course, the existence of certain historical reasons that may account for this unexpected observation explain very satisfactory why these cultures and civilizations did not show it, along with the degree of scientific advancement we may have anticipated to accompany the very high frequency of novelty-seeking alleles in these peoples. [18]

If, however, we employ a different view and try to trace the roots of this finding in the ancient history of these populations, and particularly their migratory history, we may find some additional explanations, as proposed by Chen et al. (1999) and Matthews and Butler (2011). These investigators discovered that there is an interesting correlation between the presence of the novelty-seeking DRD4 alleles and the physical distance of out-of-Africa migration in the corresponding populations. Roughly, they noticed that when longer distances had to be covered during these migrations, then they were associated with higher frequencies of the novelty-seeking alleles in the corresponding people. Consistent with that view, a plausible explanation becomes apparent. Between 20,000 BC and 10,000 BC, modern humans had colonized the entire world. In order to effectively perform these rapid migration attempts, among their other characteristics, they also needed to adapt into the new environment and also to exhibit low reactivity to novelty stressors. They had to be good explorers and they also had to be able to cope with great differences and variability when, during their trip, they had to change their habitat. Otherwise, they wouldn't be able to travel from their original sites in Africa, as far as in South America, via North America, through all these highly variable environments. Of course, it was not exactly the same individuals who left Africa that eventually settled in South America. It is conceivable that this trip lasted for a few generations and, in between certain subpopulations, quite likely settled in various locations. Probably, this process was enriched by the novelty-seeking alleles. Still, such exploratory activity had to be intrinsic to the people. Whether in that case the novelty-seeking alleles of DRD4 actually induced migration or they render the individuals that bear them feel more comfortable in the new habitats remains under debate, with the second possibility appearing as the more likely. Nevertheless, the fact is that these particular people who

originally colonized South America needed, or were assisted by, at the least, a specific genetic signature.

Thus, it is quite likely that the specific behavior induced by this genetic characteristic, that of novelty-seeking, was not as clearly demonstrated in South Americans as in Westerners, as we have seen by their prior comparison with Easterners. This can be due to the strong effects of special socio-environmental and historical reasons, or alternatively to the consequences of other genetic alleles that might have masked these effects.

7.3. Nomads and Settlers

That the 7-repeat DRD4 allele is present in Africa at variable frequencies is not surprising, considering that Africa, as explained in detail earlier, is the source of all human variation. Thus, the populations that have departed from Africa carried the polymorphisms that were already present in the populations from which they originated. However, some interesting observations that offer additional value to the potential role of this gene in affecting human behavior and, ultimately, history can also be found within certain populations in Africa that differ in the 7-repeat allele frequency.

Ariaal people are essentially nomads who wander around northern Kenya. Between 1960 and 1970, some of them, under the influence of Christian missionaries in the area, settled in certain locations, establishing societies that practiced agriculture. This represented a very strong and acute change in their way of life that, until that point and for several generations before that, was nomadic. This was also a very recent event that provided a very “informative” tool for anthropological and other studies. Eisenberg and co-workers (2008) took advantage of this naturally occurring “experiment” and examined two groups of Ariaal men that lived in Kenya. The first group consisted of the people who were still nomadic, while the second group included Ariaal people who, for approximately the last 35 years, lived in villages. Within that time frame, no considerable changes in the genetic signatures of the corresponding populations were anticipated, since the time interval did not surpass that for one or two generations. Then they studied the frequencies of DRD4 polymorphisms in association with various

nutritional indices that are considered indicative for better adaptation to the nomadic or the settled life.

The investigators found that the presence of the 7-repeat allele is associated with better nutritional status in the nomads but worse in the settled individuals. Thus, the nomads with this allele appear to possess an advantage as compared to those that do not have it, or the settlers that also have it (Figure 5). The results of this interesting ongoing evolutionary experiment, in terms of selection pressure and consequences in these populations, will be recorded in the future. These interesting implications of DRD4 in the lifestyles and behavioral patterns become even more complex in view of certain observations linking the same DRD4, novelty-seeking and "nomadic" seven-repeat allele, with the childhood onset psychiatric condition designated as attention deficit hyperactivity disorder (ADHD), and for which the major symptoms are inattention, hyperactivity, and impulsivity (LaHoste et al., 1996). It is actually not hard to identify specific similarities between ADHD and the novelty-seeking behavior. Apparently, the latter, under the influence of certain environmental factors or even that of other genes, may cross the limits that define "normal" and turn into pathologic (notwithstanding that the line between normal and pathologic is quite vague). So, the same gene that is related to a pathological condition such as ADHD also offers an advantage to nomadic life. While for a pupil in a western-style school being hyperactive and impulsive is a disadvantage, for a young Ariaal nomad it may be advantageous, as he will be of assistance to protect more efficiently and feed himself better.

Even though nomadic life stopped being as common as in the past, we may view possible remnants of such behavior in contemporary societies, particularly if we extend the concept of "moving from one physical location to another" to other attributes of daily and social life, such as concepts, beliefs, and ideas. For example, the attraction of Easterners to relatively large (and interdependent) communities, with their great attachment to tradition and things inherited by their ancestors, may reflect a settler's approach to life. Furthermore, the increased context-dependency, or in other words, the fact that they always view and understand themselves as parts of a wider whole, may also be related to that notion. This wider whole may not necessarily be restricted and defined by certain physical boundaries but can

also be extended to ideas, social structures, and relations, and generally attitudes towards life. The settler's approach implies that someone lives and dies within certain and well-defined borders, not only physical but also intellectual. These borders define the frame in which someone's life develops, and in traditional collectivistic societies it is quite likely that they have changed little between generations.

On the other hand, Westerners, perhaps, are not typical nomads, and actually many of them never were; however, they are still attracted by attitudes possessing the common denomination of "wandering around," which is an intrinsic feature of nomadic life. For example, while they have —and actually, concomitantly with the development of Western civilization they always had—developed a special relation to their home city or country, still, intellectually they are attracted by various changes, they easily doubt traditional values, and generally they are skeptics and critical against things given as such. The latter is actually a mandatory condition for the development of a rational scientific thought.

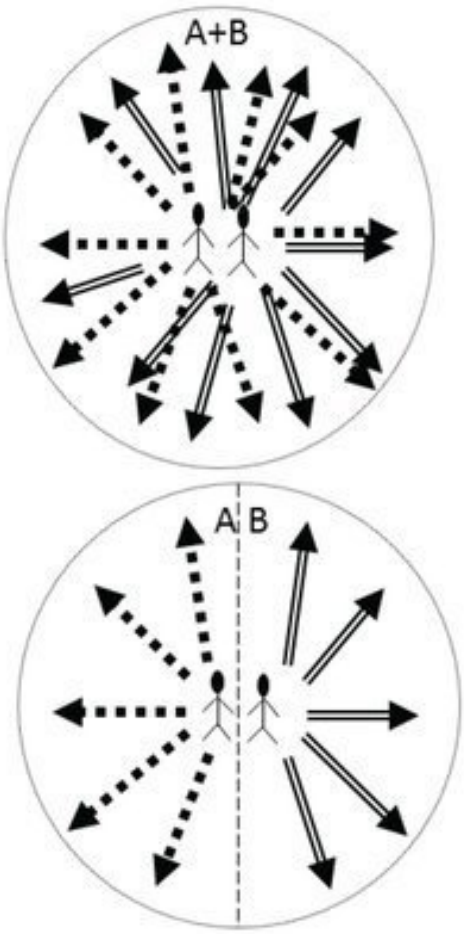

Figure 5 . Nomads vs. Settlers in food-gathering. Nomads (top), have to collect food from any possible location independently within a defined territory (A+B). Settlers (bottom) have divided the territory into sections A and B and co-operate by sharing the food they collect. Nomads are more independent and self-sufficient while frequently they have to cope with various novel stimuli. Settlers are more interdependent and they can afford developing a routine in their daily lives. Dashed and double arrows indicate food-gathering moves of each individual .

Furthermore, the whole concept of individualism described in detail earlier may also represent an expression of certain facets of the nomadic life in their widest sense. Nomads do not have an attachment against a specific physical location. By being predominantly hunters and gatherers, and by possessing herds they take with them in order to satisfy their needs for food,

they exhibit reduced interdependency with each other. In parallel with that notion, people in an individualistic society attribute increased importance to self-reliance, thus trying to reduce their dependency upon others. Money usually provides the media to do that today. And since in contemporary complex societies interdependence is very high, the preservation of individuality is maintained and satisfied by the rationalization of this interdependency and by establishing detailed laws and regulations that protect from the deterioration of society.

A remnant of this nomadic attitude can also be the little attention typically given by Westerners to the effects of their civilization on the environment. Similarly to the typical nomads, who as hunters and gatherers don't care much about the effects of their immediate actions on the environment, as long as they satisfy their needs (nature will find its way), the contemporary Westerners started to worry about the environment only recently, when they realized the catastrophic consequences of their activities.

7.4. A Gene for the Liberals

The saga of the direct implications of DRD4 polymorphisms and the organization of social and actually political life goes even further, beyond the establishment of nomadic or settler's life. In 2010, an intriguing study was published by Settle and co-workers (2010) in the *Journal of Politics* . In this study, led by senior authors N. Christakis and J. H. Fowler, authors of the classic bestseller *Connected* (2011), the investigators claimed that the presence of DRD4 7-repeat alleles is associated with political ideology, specifically liberalism. By examining about 2000 individuals, the authors discovered that by possessing the novelty-seeking allele, the number of friendships a person has in adolescence is associated with liberal political ideology. In other words, the novelty-seekers were found to be more "receptive" to the exogenous variable signals that may be expressed in the acquisition of liberal ideology. In this study, the subjects were asked the simple question: "In terms of politics, do you consider yourself conservative, liberal, or middle-of-the-road?" and had to select among the following equally simple answers: "very conservative," "conservative," "middle-of-the-road," "liberal," or "very liberal." The authors explained

their findings by hypothesizing that "[I]ndividuals with a genetic predisposition toward seeking out new experiences tend to be more liberal, but only if they are embedded in a social context that provides them with multiple points of view." Thus, having many friends and being exposed to various different ideas may affect your political ideology, provided that the genetic background is sufficiently receptive, as defined by the presence of DRD4 7-repeat alleles. In other words, a specific genetic fingerprint determines how prone one is to the influence of many different ideas, a fact that may be sufficient to make him a liberal. These investigators finally concluded to the ground-breaking (completely rational) statement that, "In light of these and other findings, political scientists can no longer afford to view ideology as a strictly social construct."

Naturally, we can only imagine what the result would be if an analogous study had been performed on individuals from a society of a different political system, especially such as those that existed during the days of the Cold War until a few decades ago, and for which conservatism and liberalism had a completely different meaning. In any case, though, a specific genetic polymorphism has been linked to political ideologies. If we turn again to Table 1 , we'll see that a nice correlation exists between people having the novelty-seeking, 7-repeat allele and political history that is rich in revolutions, drastic or not so drastic changes in the organization of their society and its structures, and (in general) societies at which political endeavors appear to play a major role in daily life. Again, we'll realize that the people who follow the legacy of the ancient Greeks, namely Westerners, and for which the novelty-seeking allele is found at higher frequency than in Easterners, are those who continuously seek for more efficient means of government, while it is also quite common for them that, during the last years of their history, a given generation has lived under quite different political conditions than the previous generation.

As opposed to them, Easterners are the ones that, by viewing their lives as an integral part of greater whole, are reluctant to perform drastic changes; they are, in general followers, of the notion of a general stability in terms of a balance—facts that can be interpreted as an attraction to conservatism.

As regards South Americans, a rather intriguing possibility that may contribute to the political instability that characterizes these nations is that due to the extensive interbreeding between the local populations and Westerner conquerors, novelty-seeking DRD4 alleles passed into their genetic pool enriching them. Therefore, contemporary South Americans, by being the product of interbreeding between the descendants of ancient South American people (that have the novelty-seeking alleles at quite high frequency) and Westerners, have probably an increased incidence of 7-repeat alleles which, and thus politically speaking, they have developed a tendency for liberalism that may also be reflected by their politically instability. The latter, of course, is heavily influenced by various additional socio-economical and historical reasons.

7.5. DRD4 and Financial Risk-Taking

The novelty-seeking behavior that is likely related to DRD4 polymorphisms and is characteristic for Westerners transcends various other aspects of daily life and is expressed in reactions and attitudes that are not imminently related to exploratory activities. It appears that financial behavior also represents another facet of this novelty-seeking behavior.

In January 21, 2010, U.S.A. President Obama, in a discussion of the possible causes of the economic crisis, stated the following: “This economic crisis began as a financial crisis, when banks and financial institutions took huge, reckless risks in pursuit of quick profits and massive bonuses.”[18]

With this statement, the president pointed to certain risk-taking decisions as a causative factor for the crisis, indicating that certain behavior patterns may have dramatic consequences in global financial stability. The question is how inherent such decisions are and whether they can really be avoided. Economists, and probably psychologists as well, might argue that such risk-taking decisions are integral to the system, and the same applies to the subsequent crisis that eventually followed. There might also be, however, a genetic component that makes these decisions more likely, explaining that the “integral” component we refer to is not limited to the financial and economical patterns related to the system *per se,* but is also extended to the

genetic features of the societies and the corresponding people that undertake these decisions.

Dreber and co-workers (2009) studied the potential role of DRD4 polymorphisms in financial risk-taking by using an investment game with real monetary payoffs. In this game, 98 males between 18 and 23 years old were given a balance of $250 and asked to choose a fraction of this amount for an investment. In case of failure, the invested amount was lost while in case of success, the amount invested was multiplied by 2.5 and returned to the participant. It was a coin flip that determined the outcome of the investment, thus having a probability of failure or success of 0.5. Analysis of the results showed that individuals with the 7-repeat novelty-seeking alleles for DRD4, on average, invested more money than the ones without these alleles, thus pointing to DRD4 polymorphisms as genetic determinants of financial risk-taking. Similar results were obtained by Kuhnen and Chiao (2009) in an analogous experiment that also identified another gene, related to the regulation of serotonin activity, as an additional regulator of financial risk-taking. [19]

What happens if we compare the risk-taking decisions between Easterners and Westerners, or the ones with the low and high frequency, respectively, of the DRD4 risk-taking alleles? Apparently, strong cultural differences do not allow a formal and legitimate comparison. Even if we analyze the results of investment games-related experiments by racial criteria involving subjects of the same population, i.e., Americans of Eastern or European origin, again certain cultural differences will be unavoidable and would affect the outcome of our analyses. Psychologists, however, argue that there are certain differences that they also ultimately attribute to cultural differences and discrepancies in the philosophical perception of life. For example, in assessing the uncertainty in answers against questions of general knowledge (internally generated uncertainty) or likelihood for the occurrence of future events (externally generated uncertainty), investigators found that Asians repeatedly showed greater overconfidence than Westerners (Weber & Hsee, 2000). Consistent with this finding, comparisons of Chinese and American students in making financial choices between options with high or low risk, showed that the latter were, in general, more risk averse than the former (Hsee & Weber, 1999).

Similarly, it was found that the perception of risk was lower in Chinese who were willing to pay, in financial experimental settings, more than the American subjects (Weber & Hsee, 1998).

These findings appear to contradict the higher-risk-taking behavior of Westerners who have the 7-repeat DRD4 allele at elevated frequency as compared to Easterners. Interestingly, this risk-prone attitude of the Chinese is limited to financial risks. In different experimental settings that assess other types of risk-taking, such as academic risk decisions (expressed as the choice between writing a paper on a conservative or provocative topic) or medical risk decisions (expressed as the choice to take a pain reliever with a moderate but sure or strong but variable effectiveness), the Chinese appeared more risk averse than Americans.

The latter observations appear to be in line with the genetically predicted risk-averse tendency of Easterners and dissociate financial risk-taking from other types of "risky" behaviors. The discrepancy in the response between the different types of risk-taking between Easterners and Westerners may reflect a different perception against monetary and, by extrapolation, against certain materialistic issues. It is quite possible to indicate the degree of self-reliance these people have towards different matters. In other words, in case of the "wrong" choice, the ease by which one takes the specific risk may imply how much help an individual is likely to receive from his or her family, environment, or society. So, Easterners actually can afford to take "risks" because their environment will support them in case of a mistake and will correct the outcome of the "bad" lack. Westerners are alone in life and they have to deal with the outcome of their doings, thus they need to be more cautious and careful. In addition to that, it may also reflect the reduced value of money as the "buying power" in the context of achieving happiness in life. Therefore, those individuals are also willing to take higher risks because they feel that they have less to lose.

Besides the ability of the Eastern cultures to reduce the harmful effects of risky choices, the perception of risk as such also differs between these cultures, which eventually affects the ease of taking the corresponding decisions. Thus, the difference in these risk-taking decisions and the confidence against the corresponding choices are likely related to the fact

that Easterners have been trained within a rigid cultural system and are used to following traditions instead of criticizing them. Therefore, they fail to recruit evidence that disconfirm their original hypothesis, a fact that eventually results in giving them increased confidence in their decisions, thus their willingness to take risks is higher. On the other hand, Westerners from very early on in their lives are being trained to criticize and to confront. Collection of arguments is not limited to those that confirm but also to those that disconfirm their arguments, thus reduced confidence is more consistent with their perception of life. Therefore, their perception of risk is increased. In turn, while Easterners appear as risk-takers, they do not consciously feel that they actually take a risk. For the same choice, they feel confident and, thus, they can go one step ahead of Westerners. So, while the experimentalist is viewing them as risk takers, they do not feel as such. A choice that is considered quite risky for Americans is not that much of a risk for Chinese. This notion is also reflected to the gambling behavior at which the Chinese exhibit significantly less probabilistic thinking and riskier gambling decisions than Westerners (Lau LY, 2005). In other words, the Chinese actually do gamble while Westerners evaluate chances and try to win.

Cultural differences complicate things even more. For example, success in business for the Chinese depends on several factors that in order of reduced significance are fate, luck, feng shui, accumulation of good deeds, and—only lastly—by knowledge (Pitta et al., 1999). For the rationale-based Western societies, apparently success should be mostly dependent on knowledge. This example illustrates nicely how external factors are important for the Chinese in determining a specific outcome. Thus luck, and consequently risk-taking has a different meaning between these two cultures which in turn, also affects gambling decisions. Furthermore, gambling is a very old and quite acceptable social tradition in China, a fact that obviously also affects greatly the perception of inherent risk. Finally, Chinese are not as proficient in risk-taking and in issues not related to financial choices. Therefore, if we were able to normalize behaviors and responses against the perception of risk, and subject individuals to risks that are perceived as equivalent, we might have expected that Westerners will display more risk-prone attitudes than Easterners. In agreement with that is the observation that Chinese are less prepared to accept certain risks than

Australians, according to a study that evaluated risk-taking (related to industrial facilities, natural hazards, etc.) in these populations (Rohrmann & Chen, 1999).

After all, risk-taking, especially in financial matters, is a rather Western approach. Development and progress, as we understand it as Westerners, require making decisions, which in turn possess a certain degree of uncertainty regarding their specific outcome. Easterners, on the other hand, are attracted by stability and harmony, conditions that diminish risk-taking.

7.7. DRD4 and Substance Abuse

Novelty-seeking, in the form of searching continuously for new experiences, does not necessarily have consequences that can be good and beneficial, or at least neutral at the level of both the individuals and that of society. Certain evidence, although not conclusive as yet, points to a potential link between the novelty-seeking alleles of DRD4 and drug abuse (Lusher et al., 2001). Furthermore, the contribution of various other genetic loci also affects the predisposition to addiction, which can mask and even surpass the effect of DRD4. However, to some extent, such a link is quite understandable, since the subjects constantly attempt to try new experiences that ultimately may turn into drug addiction.

A fair comparison of the trends of drug abuse between Easterners and Westerners is almost impossible. Socio-economic and cultural factors greatly affect the outcome of such analysis, as well as the fact that setting the threshold of socially unacceptable addiction and accuracy in recording the results of such analyses might be quite different between these societies. From what we know, however, the prevalence of such phenomena were quite high in both Western and Eastern societies. The drug problem in the West is quite self-evident in the modern world, since statistics indicate that increasing numbers of (especially young) people are drug addicts. The Opium Wars in nineteenth-century China, when the entire army was addicted to opium, and the increasing trends of drug addiction in China today, also show that the problem is at least equivalent among societies. For these phenomena, it is possible that the contribution of the socioeconomical environment plays a role that surpasses the role of genes.

One can argue that while in the West the relative ease at the availability of drugs, in combination with the demoralization of the societies and the abolishment of the role of strict values in the youth, are primary causes of substance addiction, while in the Far East, besides the side-effects of contemporary modernization, causes also included the function of drugs as an outlet against massive oppression.

7.8. Summarizing on DRD4 as a Prototype Westerner's Gene

Among the various genes associated with a predisposition against specific behavioral patterns, DRD4 is probably the one that exhibits the most striking differential distribution among Easterners and Westerners. This is not only due to the clear geographical pattern of the corresponding allelic frequencies, but also due to the variety of specific behavioral traits associated with it .

In summary, the 7-repeat allele of this gene is frequently found in Westerners but not in Asian people. This is in line with certain behavioral characteristics these populations (and cultures) have. Specifically, the 7-repeat allele has been associated with elevated novelty-seeking behavior and, associated with it, exploratory activity, increased human migrations, and a tendency towards (or better adapted to) nomadic life. Lately, it has also been associated even with liberal (as opposed to conservative) political ideology. All these features indeed tend to characterize Westerners and the cultural norms they developed, posing the intriguing possibility that DRD4 can actually represent a single gene that can "predispose" for what we understand as the stereotypic Western-type behavior. Thus, we could imagine that an individual bearing the 7-repeat allele functions more efficiently in Western society while the one without this allele would probably be better suited to a society with Eastern-like structures. Alternatively, we could propose that a society with more individuals bearing the 7-repeat is more likely to have followed historical lines and choices more typical of a Western society, while a population with a lower number (or deficient as it is the actual case with Easterners) of individuals with the 7-repeat allele would more likely attend the collective historical outcome of Easterners.

Even though we assumed that all these genetic association studies were indeed true and absolutely accurate, and that all the proposed associations were reliable and predictive for the corresponding behaviors, there is a certain issue that has to be kept in mind. As already discussed earlier, attempts to extrapolate from individuals characteristics to those of a group of people and societies possess certain dangers and specific conceptual limitations. Let's take novelty-seeking and exploratory activity as an example. Does having too many novelty-seekers in a society necessarily mean that this society will be science and exploration oriented? I doubt it. What we currently perceive as a Western-type characteristic is the collective and balanced outcome of frequently opposing behaviors while domination of one against the other, instead of "pushing" against a specific direction, may have led to some disorganization and eventual instability. Furthermore, there is not a single behavioral trait associated with a single genetic locus alone, which means that the presence of a specific allele may modulate the likelihood of more than one behavioral pattern. In other words, too many novelty-seekers, most likely, would have the nomadic characteristics to prevail and therefore, to prevent collective decisions and conscience to develop. The latter is a mandatory condition to exist in a society in order to progress in science (and not only in that) and even to proceed towards exploratory actions.

This becomes even clearer if we take political ideologies as an example. We can assume that in certain societies the presence of too many liberal-minded individuals, in terms of arguing against and criticizing given and widely accepted values and norms, bears certain dangers when evaluated at the level of the whole group of people. It is conceivable that they occasionally will be dysfunctional and unable to operate collectively as a single society. An actual observation that it is quite common in the domain of politics is that a progressive and radical political leader is usually followed by a conservative one and vice versa. They are both elected by the same political body, and actually during most of the cases, the exact same voters who now vote conservative voted for the liberal one in the previous election. This observation may express exactly this demand for a historical balance that is a mandatory condition for a society to operate efficiently. Actually, we may notice that the more conservative this leader is, the more progressive and radical his successor will be during most of the cases. We

have witnessed this in the U.S. administration during the beginning of the twenty-first century. However, I think that it is more likely for the novelty-seeker to have voted for the conservative leader following an extended administration of the progressive one, than it is for the non-novelty-seeker that is probably more reluctant against the change. In that case, if we were able to examine DRD4 polymorphisms in voters who have voted for a different party in two consecutive elections, we might have seen that the ones who changed their minds and voted differently are the novelty-seekers. In that case, those are the ones who actually determine the outcome of the elections, while the others, who are presumably the most rigid ones, represent a core body of political followers who are, in general, more reluctant to change political ideology. Of course, such an experiment has not been done as far as I know, but it might have provided quite informative insights regarding the contribution of genetics against political choices.

Vice versa, in the hypothetical societies that are completely devoid to the novelty-seeking 7-repeat allele, or analogous alleles that can substitute for, and also increase or stimulate the novelty-seeking behavior, they are quite likely to be condemned to static. While we can imagine that these societies will have a great collective perception and will be able to establish big and stable societies, they would still need their explorers and novelty-seekers to expand and liberals to doubt given perceptions and drive political advancement.

8. Serotonin Transporter and the Emergence of Collectivism

The emergence of collectivism, as opposed to individualism, represents a type of behavior that signifies important differences between the way that Eastern and Western societies have been organized. Previously, some hints regarding the onset of collectivistic behavior have been described in view of the polymorphisms in the DRD4 gene and the specific behavioral patterns they were associated with. However, according to the results of several genetic analyses, another genetic locus displays a stronger and more direct relation to the development of a collectivistic behavior. It is related to the activity of serotonin.

Serotonin is an important neurotransmitter of the central nervous system, regulating many psychological traits and behaviors. It is released in the synaptic spaces between neurons, and its activity is terminated by a specific protein designated as serotonin transporter (5-HTT), which is responsible for its re-uptake from the pre-synaptic neurons. Several psychiatric drugs target this protein, underlining its significance in the regulation of conditions related to behavior. The regulatory region in this gene is not the same in all individuals, but differs in its length due to the different repetition number of a core sequence. Thus, some individuals have longer versions of this polymorphic gene while others have shorter versions.

Two major alleles and several minor ones have been identified in the population. The major, most common allele has been designated as the *s* (short) allele, consisting of 14-repeats, and the *l* (long) allele, which has 16 repeats. These variants of the serotonin transporter gene display differences in their activity: The shorter allele is less active than the longer one, and thus serotonin is re-introduced less efficiently in the neurons. As a consequence, the neurohormone displays prolonged activity, since it stays

for longer periods outside the cell, at sites where it can be active and capable of eliciting biochemical signals. Related to this finding is the observation that, according to the results of many studies, the presence of the *s* allele has been linked with neuropsychiatric disorders, while the *l* allele is linked with better response to antidepressants.

Table 2 *. Allelic frequencies of the s and l polymorphisms in 5-HTTLPR in various ethnic populations (adapted from Goldman et al, Depress Anxiety. 2010 March; 27(3): 260–269, 2010).*

Ethnic group	% s allele*	% l allele*
Caucasians	43	57
Taiwan	67	28
Chinese	72	26
Japanese	80	19
Korean	71	29
Africans and African Americans	27	72
Native Americans	65	35

* The sum of *s* and *l* alleles is lower than 100% in many cases, because rare alleles, different than those two have not been included in the analysis

While both *s* and *l* alleles are present in virtually all specific populations and ethnic groups examined so far, their frequency in the different groups is striking in terms of their geographic distribution. Specifically, the *s* allele was found to be much more common in the populations from the Far East (at frequency ranges at around 75%), as compared to Caucasians (the frequency ranges at around 40%). Table 2 , which has been compiled from

selected independent studies, shows these differences between different ethnic groups (Murakami et al., 1999; Goldman et al., 2010). Besides the reported differences in the frequency of the *s* and *l* alleles between Easterners and Westerners, one can see that Native Americans have an *s* allele frequency of around 65%, which is slightly lower but comparable to that of the people from Asia (it ranges between 67% for the Taiwanese and 80% for the Japanese). This is probably also due to the origin of the Americans from the original migration of Asian populations towards this continent. In addition, Africans have very low frequency of the *s* allele, around 27%.

8.1. Association between 5-HTTLPR and Depression

Various psychiatric conditions and disorders have been linked to the VNTR polymorphisms that exist in the promoter of 5-HTT. One such example is the association of the presence of one or two short alleles of the serotonin transporter and major depression. According to the results of such a study, individuals with the *ss* or *sl* genotype, when exposed to stressful life events, exhibited more depressive symptoms, diagnosable depression, and suicidality when compared to those bearing the *ll* genotype (Caspi et al., 2003). Subsequent meta-analyses, being studies that cumulatively analyze experimental results published in previous studies, confirm this association (Karg et al., 2011).

That the *s* allele, however, is only linked to pathologic behavior also acts as a sensitizer in the perception of depressive signals, as it does not reflect explicitly the whole picture. Taylor and co-workers (2006) studied not only how this allele affects the negative but also the positive signals. They found that if *s* allele-bearing people were exposed to positive signals, then the depression-related symptoms were less pronounced than the ones with the *l* alleles. Thus, the presence of the *s* allele sensitizes individuals not only against the pro-depression signals but also against anti-depression signals. In that case, we can view this allele as a multiplier of those signals, while the *l* allele operates as a “buffer” or a “filter”: having it means that someone is less vulnerable against such stimuli.

Interestingly, this activity of *s* allele is not extended to all types of positive or negative signals but only to those that are related to signals elicited by other individuals and reflect social support or relations. According to a study that evaluated the effects of a natural disaster, such as a hurricane (a negative signal that was not triggered by other people), the presence of the *s* allele had no difference. It did, however, when these hurricane victims received social support: If the support they received was not that good, then the *s* allele carriers were more likely to develop depression than the *l* allele carriers. When, however, they received good support, no considerable difference was found (Kilpatrick et al., 2007). Thus, the *s* allele appears to be able to interpret and modulate social responses if interaction with other people was involved. Consistent to that notion, individuals bearing the *s* allele are more receptive and sensitive to the social group they belong to or interact with, as compared to the *l* -allele-bearing individuals, who appear as less vulnerable against these stimuli. Due to that function, the *s* allele has been recognized as a *social sensitivity allele* . This hypothesis attributes an important role for HTTPLPR in the establishment and the maintenance of social bonds and the interdependency of the individuals. In collectivistic cultures and societies in particular, social sensitivity is elevated, and this is imperative for the building of strong and tight social structures.

8.2. The Sociality Gene?

While the association of the *s* allele with increased social sensitivity (a notion that, as mentioned, is related to the collectivistic behavior) is in tune with the major characteristics of Eastern cultures, the interpretation of these results is more complicated as regards the link between HTTPLPR and psychopathologies.

The prediction is clear: since the frequency of the *s* allele is higher in Asians and the *s* allele is linked to depression, then Asian people should exhibit a higher prevalence to the symptoms of depression than Westerners. Again, we have to face the same restrictions that refer to cross-cultural studies: Quantifying depression and related symptoms in individuals from different cultures, and especially when attempting to put together and make sense out of the results obtained from analyses of independent studies,

possess certain difficulties and limitations. These limitations range from the point of how depression is being diagnosed, to the ease by which individuals present themselves to appropriate practitioners in order to have their potential depression recorded, and ultimately to the clear definition of a sharp borderline between what normal and what pathological is. Regardless of these restrictions, though, the answer is clear and probably intuitively anticipated: There is indeed a correlation that is present, but it is a negative correlation, actually. Populations with high frequency in the *s* allele, such as Easterners, have a lower instead of higher prevalence of depression than Westerners. In other words, people from Western cultures suffer more frequently from various manifestations of depression and general mood disorders than those of Eastern cultures (Chiao & Blizinsky, 2010). Reasons related to different criteria in classifying these conditions and reported incidences in different cultural environments, may, to some extent, explain these discrepancies, although not sufficiently .

We have to keep in mind that studies identifying the *s* allele as a depression-related allele involve, in principle, populations of the same culture. Thus, the specific effects of the cultural environment were excluded or diminished. Comparing results of studies that involved individuals of different cultural background could have solved this issue, but it is rather difficult to assume that exactly the same individual criteria have been applied in order to record depression effectively. No matter how strict and rigorous the criteria used were, a subjective factor could not have been avoided and ruled out.

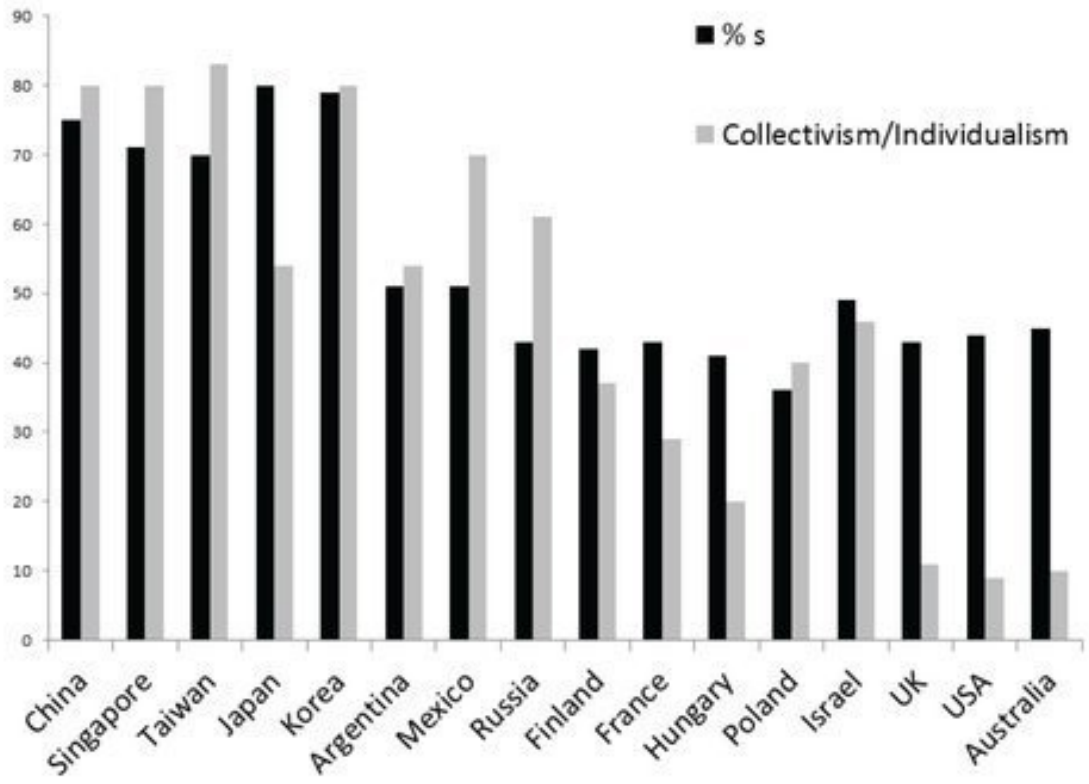

Figure 6 . Correlation between the frequency of the s allele in 5-HTTLPR and collectivistic behavior. The datawere adaptedfrom Chiao& Blizinsky(2009) and Hofstede (2001).

Taking into consideration cumulatively the results of such analyses, another interesting association can be found between the frequency of the *s* allele and a specific characteristic that at this time instead of referring to individual people, refers to whole cultures (Chiao & Blizinsky, 2010; Way et al., 2010). This characteristic is related to the development of individualistic or collectivistic cultures, as described earlier in detail, when the former type of culture was defined as a predominant characteristic of ancient Greeks and their derivative Western civilization, while the latter was attributed to the Chinese and their derivative Eastern or Asian cultures .

We can easily see that in cultures with a rather individualistic perception of life, the frequency of the *s* allele is low, while the *s* allele is more common in people from collectivistic cultures. Figure 6 clearly shows this

correlation. In this figure, data on the degree of collectivity in various different cultures were obtained by Hofstede (2001).

Various questions arise from these observations. First of all, coming back to the discrepancy described earlier, how is the high *s* allele's frequency accompanied by low prevalence of depressive symptoms and, generally, manifestations of anxiety and mood disorders in Asians? A proposed explanation is that individuals carrying the *s* allele, by developing a tendency for collectivistic values, at the same time provide themselves with a protective niche against symptoms of depression and also from stimuli that may trigger negative emotions and eventually psychopathologies (Chiao & Bizinsky, 2010). In other words, collectivism is protective for the ones in need and acts as a safety valve that buffers the consequences of such negative stimuli. This is also in agreement with the previously mentioned role of the *s* allele in interpreting social support. In that case, how did, at the first instance, Asian people exhibit higher *s* allele frequencies? Or, alternatively, did they have to develop (or be selected for this trait) this protective mechanism while Westerners did not? It is possible that this just reflects the *s* allele frequency in the people who originally inhabited these areas. It turns out, though, that the presence of the *s* allele offers another advantage that is also tightly related to the specific environmental conditions: epidemiological studies indicate that the collectivistic values offer an advantage against the transmission of disease-causing pathogens (e.g., typhus, malaria, tuberculosis), all of which exhibit high prevalence in geographical areas at which collectivistic values are more prominent (Chiao & Bizinsky, 2010; Fincher et al., 2008). So people in these collectivistic societies are less vulnerable to the fatal effects of these contagious diseases. Selective pressure, though, represents just the one face of the coin because phenomena related to genetic drift can also offer satisfactory explanations as regards the high frequency of the *l* allele in Westerners when compared to the higher frequency of the *s* allele in Easterners.

8.3. The Greek Confucius and the Chinese Aristotle

In any case, we can imagine the following scenario: First we consider the fact that the *s* allele predisposes for collectivistic behavior and strong social norms as a given. In that case, we can assume that originally among the

people who migrated towards Eastern Asia, the ones that carried the *s* allele had an advantage because the new environment, rich in contagious pathogens, favored individuals with the collectivistic behavior (or the populations-communities at which collectivistic behavior prevailed). The beneficial effects of the *s* allele, at the first instance, were probably related to the contagious diseases present in the corresponding areas. However, other features of the *s* eventually started to prevail, and at this time, they were associated with the mode of social organization. Thus, they developed cultures and societies characterized by collectivistic values. In these cultures, the "whole" has a dominant role against the sum of its constituent entities (the individuals), and in order to function as such, the individuals that participate in this "whole" need to exhibit high interdependency. In other words, the others, as a society, are needed to have a strong effect on each and every individual, establishing a spectrum of interrelationships that operates as connective glue in these societies. In turn, among the various consequences in their respective collectivistic cultures, the high frequency of the *s* allele also protected the individuals against the psychopathologic symptoms of depression and related disorders. We can say, then, that it is Confucius and not Aristotle who was better suited for East Asia, because the *s* allele rendered the people that followed his teachings more successful in this particular environment. Besides the contagious diseases, we can also speculate that farming, due to the specific environment in the East, could be practiced quite extensively and in order to do so, the people were required to establish a degree of collectivism. Vice versa, in ancient Greece, it was Aristotle who was better suited than Confucius, not necessarily because the *l* allele offered a particular advantage, but also because the *s* allele did not have a particular role to prevail. Assuming, however, that if among the people that originally inhabited ancient Greece, the frequency of the *l* allele was considerably lower than what it was, and thus, could not survive after a few (or several) generations, or that malaria was a common disease in these areas, then things might have been different and Confucius, or a Confucius-minded individual, might have been the philosopher with the greater impact on Western philosophy. So, it was the specific environmental conditions that apparently drove the selection of specific alleles in certain populations, which in turn developed particular cultural attitudes and norms .

Someone may argue the operation of an alternative scenario that might actually have resulted in a similar result. That Easterners, despite their high frequency of the *s* allele, appear less vulnerable to its potential psychopathological consequences (lower prevalence of depression in the East than in the West), which may indicate that in a society of many more individuals with the *l* allele, the *s* allele appears to be disease-associated, just because it is reactive to the cultural majority dictated by the *l* allele-bearing people. In a society that is dictated and underlined by the *s* allele's cultural norms, the *s* allele is not disease-associated and neither—of course—is the *l* allele. In that case, taking this line of thought a step further, one may argue that it is the *l* allele and the resulting cultural line that is the "disease-associated" one, while it is the *s* line that is the collectivistic one, and the line that is actually closer to people's individual needs and capacities.

The slight difference introduced by this latter scenario is that the disease-associated symptoms contributed by the *s* allele are rather reactive than causative per se. Indeed, individuals with East Asian origin who live in the U.S.A. suffer more frequently from depression than individuals living in East Asia, as evidenced by analyses at which the same criteria for the diagnosis of the disease were used (Chang 2002; Hwang & Myers, 2007; Way & Lieberman, 2010). Thus, in different (sub)-groups of people who carry the *s* allele at the same frequency (Asians), it is the *l* allele's frequency in the overall society that harbors these individuals that triggers (or protects them from) the psychopathologic behavior. In that case, what really matters is the combination of the *s* allele's frequency in the study group, as compared to that of the total *s* allele's frequency in the whole (super)-group in which the study group belongs to.

8.4. A Gene for Happiness

The results of behavioral genetic studies frequently attract headlines. The reason that they are appealing to the reader is related to the fact that they are either revealing hidden aspects of our lives or maybe even because they rationalize certain behaviors (and potentially offer alibis for certain behavioral tendencies). Moreover, they justify certain social attitudes and reactions. This was also the case with a study by De Neve et al. (2010) that

explored the genetic basis of happiness. Press heralded these findings as a step closer to a happier society. The fact that these studies involve genetic analysis and specific experiments makes the results very objective, at least as compared to analogous results obtained by more theoretical and classical approaches. Noteworthy, this particular research group included researchers who have published results on the genetic basis of liberal political ideology or leadership, as we discussed already or that we'll see in subsequent chapters, respectively.

In the study about happiness, the investigators focused on the self-perception of happiness, asking participants the following simple question: "How satisfied are you with your life as a whole?" The potential answers ranged from "very dissatisfied," "dissatisfied," "neither satisfied nor dissatisfied," "satisfied," to "very satisfied." Subsequently, the results of these questionnaires, which involved about 2,500 individuals, were analyzed in combination with the allelic frequencies of 5-HTT polymorphisms. The experimental groups also involved twins, which is of particular importance in such studies because it permits the assessment of whether a particular characteristic possesses a genetic component, and if it does, to get an idea of the extent of this genetic contribution. Complex mathematical analysis followed, and the results confirmed that the perception of happiness bears a significant genetic constituent. More importantly, they provided specific evidence that bearing the *l* alleles of 5-HTT increases someone's chances to feel satisfied with his or her life. Interestingly, this does not apply simply to the presence or absence of the corresponding alleles (*ss* genotypes vs. *ls* and *ll* genotypes), but also extends to the number of the *l* alleles the individual bears: *ll* individuals have almost double the chance to feel very satisfied with their lives, as compared to the *sl* individuals.

That the *l* allele is more common in Caucasians, as compared to Asians, predicts that Westerners should feel more happy and satisfied with their lives than Easterners. It's practically impossible, though, to compare whole nations and cultures in terms of happiness. After all, each and every culture's purpose is to offer a "meaning" in peoples' lives, make them content, and ultimately, in its widest sense, to make them feel happy. Many parameters are involved in the quantification of such statements, and even

the perception of happiness likely differs between cultures. On the other hand, even if the incidence of certain psychopathologies represents an indication of pathological unhappiness, again, for reasons discussed in detail elsewhere, no valid and accurate comparison can be made.

Intuitively speaking, though, I have to admit that I would rather expect Asians to be happier in general, than Westerners. I cannot support this by specific arguments, but I think that the reason for that is related to the individualistic approach of life that the people possess in Western societies: By operating under individualistic norms, it is unavoidably stressful, a condition that operates at the expense of the perception of individuals' happiness. In the absence of the protective niche that is present in collectivistic societies—and as previously mentioned likely protects from the symptoms of depression and other psychopathologies—the perception of happiness is reduced. We can witness this in our individual lives, that insecurity is tightly related to unhappiness. The high frequency of the so-called happiness-associated allele in Westerners suggests the opposite: People from the East should feel less happy than people from the West.

I can only think of two explanations that may argue against this phenomenological discrepancy. First, evaluating, and even more importantly, self-assessing the level of satisfaction in someone's life, hides a latent but definite individualistic notion: Only under individualistic terms is the satisfaction in an individual's life central and intrinsically related to the notion of happiness. Consistent with a collectivistic notion for life, this attitude of pursuing happiness is probably replaced by other notions, at which Western-perceived happiness is of reduced significance. In simple words, what makes Asians happy and satisfied is different from what makes Westerners happy. Even more important than that is the fact that while Westerners seek happiness at the individual level (and eventually reports it on an individual basis), Easterners are likely to attempt to pursue happiness as part of the greater whole in which he belongs. After all, the pursuit of happiness is not a major issue for Easterners, for whom a more appropriate notion is probably contentment. Thus, a comparison cannot be made, and even the notion of satisfaction is meaningless. It's like the oranges and apples comparison.

Another possibility is that, despite the restrictions and limitations related to the stress and tension of their individualistic society, Westerners feel happier than Asians because they view their lives as a trip with a specific starting point and a well-defined destination. This notion opposes the circular mode of life that is closer to the Asian perception. Thus, Westerners are able to set and achieve specific and measurable goals that can be perceived as an achievable milestone for satisfaction and happiness. The same question in the Asians might be irrelevant. In other words, for Westerners, it's the trip instead of the destination that may make someone happy .

This notion has been successfully expressed by Konstantin Ka-vafis, the famous early-twentieth-century Greek poet who started his poem "Ithaca" as follows:

When you set out on your journey to Ithaca,
pray that the road is long,
full of adventure, full of knowledge.

8.5. Combined Polymorphisms in DRD4 and 5-HTT Promoter

The two polymorphisms discussed earlier, namely the 7-repeat allele for DRD4 and the *l* allele for 5-HTT, have been associated with Western-type behaviors. The first one, among the other traits for which associations were found, was linked to novelty-seeking, liberal behavior, risk-taking, and substance abuse, while the latter with individualistic behavior. Since none of these two polymorphisms characterize exclusively the two populations, Asians and Westerners, many individuals in both geographical regions have the 7-repeat of DRD4 and the *s* allele of 5-HTT, or the 4-repeat DRD4 allele with the *s* allele of 5-HTT. An anticipated question, of course, in that case is what happens if these two polymorphisms co-exist in the same individuals? Do novel behavior patterns arise, or are the pre-existing ones becoming more intense? In other words, does the presence of both 7-repeat and *l* alleles indicate a genetic predisposition for a super-typical Western-type behavior and vice versa? Does the presence of the *s* allele for 5-

HTTPLPR, combined with the absence of the 7-repeat allele for DRD4, imply a pattern of behavior that is very typical for Easterners?

Fortunately (or un-fortunately!), things are more complex than that. Let's see what such analyses that co-examined the presence of both alleles found. In fact, several studies are available in which the combination of 5-HTT and DRD4 was explored. However, their vast majority concentrated in their effects on certain psychopathological conditions. We'll try here to omit these studies and focus only on some of them that have limited their analysis at certain behaviors but not pathologies. In 2004, a study by Szekely et al. (2004) reported that at least in Caucasians, an *s/s* 5-HTTLPR combined with the 7-repeat DRD4 genotype showed a higher mean harm avoidance [20] score (Stallings et al., 1996) than the other groups. Noteworthy, while the corresponding DRD4 genotype is the one that is common to Westerners, the 5-HTTLPR genotype is the one that corresponds to the alleles that are more prevalent to Asians. In a different experimental setting, involving evaluation of temperament in infants by using a set of standard episodes eliciting fear, anger, pleasure, interest, and activity, Auerbach et al. (2001) reported that a certain combination of DRD4 and 5-HTTLPR alleles was associated with a shorter duration of looking during block play. These genotypes again were the long, novelty-seeking alleles for DRD4, combined with the *s* alleles for 5-HTTLPR. At the same trend were also the results of another study that took place in 15-year-old adolescents: individuals carrying two copies of the 5-HTTLPR short allele (*s* allele) and the DRD4 7-repeat variant scored highest on aggressive and/or delinquent behavior compared to other genotypes (Hohmann et al., 2009). In another study performed by Lakatos and co-workers in 2003, infants with the 7-repeat DRD4 allele that were also homozygous for the short form of 5-HTTLPR (*s/s*) showed more anxiety and resistance to the stranger's initiation of interaction than infants bearing the 7-repeat DRD4 allele along with the *l* allele for DRD4.

Contrary to this "bilateral" association between the "Western" DRD4 allele and the "Eastern" 5-HTTLPR allele, Auerbach et al. (1999) reported that infants with the *s/s* 5-HTTLPR polymorphism who were also lacking the long DRD4 alleles associated with novelty-seeking showed more negative emotionality and more distress to daily situations, temperament

traits that are perhaps the underpinning of adult neuroticism. This study took place in two-month-old infants.

With the exception of this last study, which showed that the "Eastern" type alleles (*s* for 5-HTTLPR and the short (non-7-repeat) DRD4) exhibited an interaction, the other, aforementioned studies showed that if an interaction is there, it is between an "Eastern" and a "Western" allele. In that case, and depending on the exact experimental setting, this interaction was exemplified as a shorter duration of looking during block play in infants, evidence for aggressive behavior in adolescents or harm avoidance in adults.

These results are far from being definitive, of course, and probably discussing the implications of these findings is very premature. What is important is to notice that if, indeed, certain alleles were not only associated but actually contributed to a Western- or Eastern-type behavior, this doesn't necessarily mean that by putting them together we will obtain for sure a kind of interaction or synergy. Interestingly, though, and if we indeed have obtained an interaction with the bilateral combinations (one Western- and one Eastern-type), as these preliminary studies proposed, an interesting argument could be made: All these traits that are influenced by the aforementioned bilateral interaction can be considered as negative (not pathological, though) in the long run, if we view them at the level of the society: Shorter duration of looking in the infants can be indicative of less-efficient learning capabilities, while increased harm avoidance and "fear" of strangers can eventually reduce personal interactions and develop eventually as an obstacle in the overall advancement at the level of society. Tendency for aggression in adolescents is also an apparent negative trait at the level of society.

So, if these bilateral combinations between 'Eastern" and "Western" genes indeed exhibit a "disadvantage," this might be indicative for the operation of a latent mechanism that, besides all other predominant mechanisms discussed earlier (genetic drift during initial migrations and natural selection and "fit"), has augmented the diversification between Eastern and Western people: Differing in two instead of a single trait makes individual people and populations more distinct.

8.6. MAAO and Collectivism

Among the genes that potentially affected the development of collectivistic behavior is the one encoding for the enzyme monoamine oxidase A (MAOA) that breaks down neurochemicals such as serotonin and dopamine. This gene is also polymorphic at its regulatory region: Different alleles exist in the natural population that differ in the number of repetitions of a core tandem repeat (upstream element variable tandem repeat, uVNTR). Among these alleles, the ones with three and four repeats are the most common in the global population, with the latter exhibiting higher activity than the former (Pai et al., 2007). As shown in Table 3 , interesting differences also exist in the frequencies of MAOA-uVNTR in the world population. In general, results from several studies indicate that the 4-repeat allele (individualistic) is more common than the 3-repeat (collectivistic) allele in Westerners, as compared to East Asian people. While the ratio between the 3-repeat and the 4-repeat alleles in Easterners is in the range of 65% vs. 35%, for Westerners this ratio is reversed to 35% vs. 65% (Pai et al., 2007; Jorm et al., 2000; Deckert et al., 1999; Hamilton et al., 2000).

Certain behavioral traits have been linked to the polymorphisms of this gene. The MAOA-uVNTR has been associated with differential sensitivity against the social environment in a manner that is consistent with that among the individuals with the low-expression allele (the 3-repeat allele, that is actually more frequent to Easterners), who had adverse childhood experiences; they also had the lowest levels of antisocial or violent behavior (Kim-Cohen et al., 2006; Widom et al., 2006; Ducci et al., 2007). The explanation for the aforementioned tendency and the link to the collectivistic one, as opposed to the individualistic behavior, is likely similar to that described earlier for 5-HTTLPR. It is tightly linked to the existence of a strong social support network that eventually strengthens societal bonds and ultimately collectivistic behavior and norms. Again, collectivistic behavior appears to protect from negative stimuli.

Table 3 *. Allelic frequencies of the 3 and 4– repeat polymorphism in MAOA -uVNTR in various ethnic populations (data were adapted from Pai et al, 2007, Forensic Science Journal 2007; 6(2): 37-43.*

Ethnic group	% 3-repeats*	% 4-repeats*
Chinese Han in Taiwan	63	36
Japanese	62	38
Asian/Pacific islanders	61	38
White/non Hispanic	33	65

* The sum of *s* and *l* alleles is lower than 100% in many cases because rare alleles, different from those two, have not been included in the analysis.

Also analogous are the findings for another polymorphism in the MAOA gene, at position 118, at which there is an A to G substitution that, in turn, results in the A and the G allele, with the latter being considered the "social sensitivity allele" that is most common to Easterners (Way & Lieberman, 2010). However, among maltreated children, the ones with high expression MAOA alleles were less likely to develop antisocial problems, implying that the MAOA gene is an important modulator of the sensitivity and of the subsequent responses of certain environmental stimuli (Caspi et al., 2002).

In addition to the interpretation of certain stimuli, an "endogenous" pattern in specific negative behaviors exists, which is not necessarily linked tightly to the exposure at such negative stimuli. Indeed, a direct association between the MAOA-uVNTR polymorphism and aggression has also been proposed: Individuals carrying low-expression versions of the MAOA-uVNTR alleles (such as the 3-repeat allele) exhibited higher trait aggression than the individuals with the high-expression alleles (such as the 4-repeat alleles), according to a study that involved a sample group consisting of about 28% European-American, 40% Asian, 15% Hispanic, 6% African-American, and 9% "mixed" or other, and was performed at the University of California at Los Angeles community (Eisenberger et al., 2007). This study, notwithstanding the statistical significance of the results, involved a limited number of participants (n=32) and was largely based on a self-

assessment of aggression by answering questions such as “How bothered do you feel about . . . having urges to beat, injure, or harm someone?” “. . . feeling easily annoyed or irritated?”

Also analogous were the results of another experiment synthesizing approaches of psychology and behavioral economics (McDermott et al., 2009). In this study, the investigators found that the low-expressing MAOA alleles predict aggression following provocation. The experimental setting was based on the premise that individuals were making a payment to punish those they believed had taken money from them by administering varying amounts of unpleasantly hot (spicy) sauce to their opponent (McDermott et al., 2009). Thus, the investigators were able to study the effects of the specific MAOA genotypes in association with the willingness of the subjects to engage in physical aggression toward another when they believed that they had money taken from them. Their analyses indicated that low-activity MAOA individuals exhibited increased chances to engage into this aggressive behavior. Interestingly, the hot sauce they used for the punishment could have been traded for money. Therefore, it had a specific monetary value. So, the “satisfaction” of administering this punishment comes with a certain cost to the individuals that render it. In that sense, their behavior is not costly only to the others (the ones they want to punish) but also to themselves! This behavior is termed “spite” and is thought to represent the “neglected ugly sister of altruism” (McDermott et al., 2009), exemplifying how close altruism can be with this type of aggressive behavior.

In addition to those studies, another experimental study in male mice that do not have a functional MAOA gene showed that these animals are more aggressive than their wild-type counterparts, which fully supports the notion that variation in MAOA expression is causatively linked to the development of an aggressive behavior (Cases et al., 1995).

It is finally noted that a controversial study has also linked MAOA polymorphisms to the acquisition of a warrior behavioral pattern, according to data obtained after analysis of MAOA polymorphisms in Maoris in New Zealand. The corresponding study has attracted several headlines, as it has

identified a direct genetic predisposition to aggression (Lea & Chambers, 2007).

Given the distribution of the corresponding polymorphisms, the aforementioned findings predict that aggression should be more common to Easterners than Westerners. While again a formal comparison cannot be made, it appears that such a statement contradicts the anticipated observation, that aggression should be reduced in the collectivistic societies that are structured in a manner at which the seeking of harmony plays a major role.

However, taking together all these results about MAOA, we may hypothesize that while the low-expression alleles are linked to aggressiveness, the "anti-social" effects of this apparently negative behavior are minimized, and likely masked, by its concomitant association with the collectivistic behavior. The latter trend apparently functions protectively, by scaling down the probable negative consequences or even the expression of aggressive behavior in society. This can be the case with Easterners, that while they possess the 3-repeat, low-expression allele at high frequency, aggressiveness does not apparently predominate within their societies because other protective norms exist, such as those associated with collectivism. Consistent with that notion, although more individuals may be more prone to aggression in these societies, the concomitant collective norms that they develop are protective. In other words, individuals feel that they may have more to lose than to gain by being aggressive.

In addition to that, the fact that MAOA-associated aggression (low-expression alleles) is particularly linked to provocation (McDermott et al., 2009) may imply additional clues regarding the function (and maintenance) of such collectivistic behavior. It may indicate the operation of strong societal norms that may nurture the concepts of revenge, punishment, and maintenance of strongly hierarchical societies. The latter can be seen in the East, in which certain codes of honor transcended the history of the Far East and played their role in the maintenance of the rigidness in corresponding societies. If the fear of punishment is strong and imminent, this operates at the expense of individualism. Social structures are rigid, facts that may be expressed as a tendency to collectivistic behaviors.

In Western societies, in which the protective effects of collectivism are not present, aggressive behavior is more easily expressed (and people get away with it since punishment is not that strong and imminent), and occasionally it even becomes dominant, although at the genetic level it may be initiated by a smaller number of individuals. At this point, of course, we have to recall some thoughts we described in chapter 6, on discussing the individual's as opposed to the population's traits that may explain, at least in part, why a higher number of aggressive individuals does not necessarily mean "more aggressive" populations and eventually societies.

9. COMT, Altruism, and the Evolution of the "Warrior versus Worrier" Strategies

Catechol-O-methyltransferase (COMT) is an enzyme that is responsible for the inactivation of catecholamines in the synaptic cleft. Widely known and extensively studied, catecholamines are the hormones dopamine, adrenaline, and nor-adrenaline. Among their other functions, they regulate the response against stress that, in turn, in vertebrates, is exemplified by a "fight or flight" reaction against threats (Cannon, 1929). This response simply means that when an animal (including humans) encounters a specific threat, immediately it has to select between dealing with the threat (fight) or depart in order to avoid it (flight). In any case, the ultimate purpose of this response is to deal successfully with the danger and, among its various rapid adaptations, also involves certain changes in the body's physiology that aim to give a burst of energy and strength. Whether it's going to be "fight" or "flight" depends on various parameters, but at the level of the body's physiology, both trigger a set of similar neurochemical adaptations.

Catecholamines play a major regulatory role in this process and the development of the corresponding response. The fact that COMT inactivates the catecholamines predicts that this enzyme can be a modulator of this response in a manner that is consistent with that under stress; increased COMT activity results in lower dopamine levels, a condition that in turn is associated with improved dopaminergic transmission and better performance. More efficient dopamine clearance can be seen as better acute responsiveness against the specific stimulus. Indeed, a polymorphism in the COMT gene exists in the population and is directly related to the activity of COMT. At position 158 of the protein, a G to A transition exists in the

population that changes the aminoacid valine (Val) to methionine (Met). This change is related to higher activity of the Val-bearing allele, as compared to the allele bearing Met. Thus, Val-bearing individuals, under stress, have better performance, as compared to the individuals with the Met allele .

Now, let's see how these neurophysiological changes might be linked to behavioral patterns and strategies. Intrinsically related to the final interpretation of the "fight or flight" response are also the "warrior or worrier" strategies. Roughly speaking, a "warrior" is someone who exhibits an advantage in the processing of aversive stimuli and who performs better under stress; a warrior is characterized as one who achieves maximal performance despite threat and pain and who is more efficient in dealing with the threatening environment. Simply speaking, this individual is more intuitive and can be described as a person of action.

On the other hand, the "worrier" is someone that has an advantage in memory and attention tasks, is more exploratory and efficient in complex environments, but who exhibits worse performance under stressful conditions (Stein et al., 2006). COMT polymorphisms have been associated with this behavior, with Val-allele individuals being the warriors and *Met* -allele individuals the worriers.

In view of these findings, let's see how the two alleles of COMT are being distributed around the world according to Palmatier et al. (1999). As shown in Table 4 , the G allele is more common to Asian populations, as compared to Europeans.

While in Europeans the G allele's frequency ranged at about 40%, in East Asian populations its frequency was above 70%. So, it appears that Asians are likely to be warriors while Westerners worriers. According to the results of Palmatier et al. (1999), South American populations had high but variable allelic frequencies for the G allele, being 0.66, 0.81, and 0.99 for the native Surui, Karitiana, and Ticuna [21] people, respectively. A similar observation was made for the African populations tested. For Africans, this variability is not surprising, since Africa, as already mentioned and discussed earlier, is the source of all polymorphisms found in present populations. For the South American populations, it may simply reflect

different allelic frequencies in the original populations that settled these areas and established the corresponding populations. It also reflects the genetic similarity of the South Americans and the East Asians.

Similar were the results obtained from the HapMap project. [22] Table 5 shows the frequencies of the A and G allele according to the HapMap project for the single-nucleotide polymorphism designated as *rs4680,* which corresponds to the COMT polymorphisms discussed above. In this table, Western populations include Utah residents with European ancestry and Italians from Tuscany .

Table 4 *. Allelic frequencies of the G and A alleles of COMT in different world populations. (Data adapted from Palmatier et al., 1999, Biol Psychiatry 1999, 46, 557-567).*

Ethnic group	G allele frequency	A allele frequency
Africa		
Biaca	0.93	0.07
Mbuti	0.78	0.22
Yoruba	0.63	0.38
Europe		
Irish	0.48	0.53
Danes	0.38	0.62
Finns	0.47	0.53
Mixed Europeans	0.44	0.56

East Asia		
Cambodians	0.71	0.29
Chinese	0.69	0.31
Japanese	0.79	0.21
Atayal	0.85	0.15
South America		
Ticuna	0.81	0.19
Surui	0.66	0.34
Karitiana	0.99	0.01

Of course, the same argument can also be made for European populations, since the European continent was settled by successive waves of migration events, but in that case, COMT allelic frequencies for these populations are very similar. Why this variability persisted in South Americans is hard to speculate. It may reflect the extent of interbreeding between these people, a possibility that can be tested by analyzing allelic frequencies in other polymorphic genetic loci. It may also be associated with specific advantages conferred by the corresponding alleles to these populations. We also need to keep in mind that the aforementioned populations in South America were very small, and thus, random drift phenomena related to the genetic constitution of the founders might have been exaggerated .

Table 5 *. Frequencies of rs4680 polymorphism (G/A) in the COMT gene in different populations according to the HapMap project.*

Population	**G allele frequency**	**A allele frequency**

African ancestry in Southwest USA	0.745	0.255
Utah residents with Northern and Western European ancestry from the CEPH collection	0.522	0.478
Han Chinese in Beijing, China	0.702	0.298
Chinese in Metropolitan Denver, Colorado	0.700	0.300
Gujarati Indians in Houston, Texas	0.580	0.420
Japanese in Tokyo, Japan	0.715	0.285
Luhya in Webuye, Kenya	0.685	0.315
Mexican ancestry in Los Angeles, California	0.610	0.390
Maasai in Kinyawa, Kenya	0.724	0.276
Tuscan in Italy	0.540	0.460
Yoruban in Ibadan, Nigeria	0.686	0.314

An interesting observation regarding the evolution of the COMT alleles is that in non-human primates, such as gorillas, chimpanzees, bonobos, and orangutans, only the G allele that corresponds to Val (warrior allele) has

been detected (Palmatier et al., 1999). So, the earlier human ancestors had the Val allele. This implies that the A allele, which corresponds to the aminoacid Met (worrier allele), appeared more recently in evolution, after the divergence of the ancestors of modern-day humans. So, simply speaking, our evolutionary ancestors were originally warriors and then they become worriers!

By using a financial-based experimental setting, Reuter et al. (2010) reached another interesting conclusion regarding the possible contribution of the COMT polymorphisms in regulating altruistic behavior. According to a biological definition of altruism, this behavior results in the reduction of the individual fitness but increases the fitness of other individuals in the population. Thus, it is tightly associated with social behavior. In this study, the investigators evaluated the amount of money donated by an individual to a poor child in a developing country after the subject earned money by participating in two straining computer experiments (Reuter et al., 2010). In this study, the participants, after having earned money in a gambling experiment, had the chance to donate a fraction or all of their money to a cute little girl from Peru. Analysis of the amount of money donated (altruistic tendency in behavior) in association with the corresponding COMT genotype showed that individuals carrying at least one Val allele donated about twice as much money, as compared to those participants without the Val allele. As expected, this research attracted several headlines, since the news for the identification of an altruism gene may have various implications in many aspects of life. The fact that altruistic tendencies possess an element of impulsivity indicates that it is not surprising that altruism is associated with the behavioral pattern of warriors (Easterners). On the other hand, the worriers, who are not that impulsive and often attempt to predict and consider the long-term consequences of their actions, are more reluctant to behave as altruists, since this may cost them in the long run (the Westerners). Moreover, the latter's altruistic behavior is more likely exerted only when the associated benefits of altruism are proximal. In a recent study that examined the tendency toward altruistic behavior in a group of Americans, as compared to a group of Chinese, the former appeared more altruistic than the latter. When the investigators assessed the willingness to be altruistic towards out-group members whose intentions were uncertain, the Chinese exhibited higher levels of altruism than the

Americans (Lee et al., 2008). So, in the Americans, a hidden element of reciprocity is latent in their action of altruism.

Let's summarize all these findings: Of the two COMT alleles, the ancestral one that corresponds to the amino-acid Val is associated with the "warrior" behavior, an altruistic tendency, and is more common to Easterners. On the other hand, the allele corresponding to the amino acid Met is more recent in terms of evolution, is associated with "worrier" behavior, exhibits less intense altruistic behavior, and is more common to Westerners. Do all these make sense in terms of the current Eastern and Western cultures as we perceive them? As regards the altruistic tendency and by keeping in mind all these factors we described above regarding individualism and collectivism, Westerners are probably less altruistic than Easterners; this is in line with their individualistic norms. So at the level of society, it can be argued that the specific Met-bearing COMT allele contributes to the buildup of Western individualism. Opposed to this, Easterners' increased frequency of the Val-bearing "altruistic" allele fits quite well with the construction of a collectivistic society: You have to be an altruist at some degree in order to understand the benefits of collectivism. By being a pure individualist, you only understand "good" as defined and reflected by your sole existence.

It is probably more complicated than that as regards the warrior and worrier attitudes. Warrior-like behavior is the one that tends towards actions dictated by impulsivity and confrontation and eventually may result in a constant turmoil. These notions are by far more suitable to describe Westerners, as compared to Easterners. Life in a Western and Westernized society is competitive and stressful, with a diminished sense of security, since nothing should be considered as a given and ultimately everybody has to fight in order to gain and then maintain his or her position in the society. However, because Westerners genetically are more prone to the "worrier's" behavior, they appear to prefer compromise over confrontation, stoicism, and the resolution of the disputes in a longer-run perspective than guided by a short-term outcome. An apparent contradiction develops, especially as regards the COMT-predicted preference of Westerners for compromise and stoicism (that appear as collectivism-related attitudes). A simple explanation for this discrepancy from the anticipated, "logical" observations

and predictions could be that the contribution of COMT variability as regards this particular aspect of behavior is “recessive,” as compared to that of other genes, such as the HTTLPR and MAOA described in previous chapters. In other words, maybe in Easterners, the “warrior”-prone COMT allele encoding for Val, contributes less to collectivism than the Met-bearing “worrier” allele, but its effects are surpassed by the high prevalence of the *s* allele for 5-HTTPLPR .

Another plausible explanation is that what signifies the aforementioned discrepancy should not be the high incidence of the “warrior’s” Val allele of Easterners, but rather the higher prevalence of the “worrier’s” Met allele in Westerners. Consistent with this notion, Westerners have built quite complex societies characterized by a complicated structure reflected in all aspects of life. Eventually and unavoidably, problems that occasionally may appear should seek for a long-term resolution that could not be solved by an individualized approach. On the other hand, people that exhibit increased memory and attention, as well as efficiency under complex environments, would be better suited for these complex societies, such as those that characterize Western culture. To that end, a “worrier’s” behavior appears better than that of the “warrior’s” in the West. In that case, it is the feature of the increased efficiency in complex conditions that supersedes the altruistic behavior that in turn characterizes the contribution of the COMT allele in Westerners. That COMT-conferred altruism does not become obvious in the West is probably due to the fact that the contribution of the corresponding allele is masked by other, “non-altruistic” alleles that are present in these populations and signify a “non-altruistic” behavior.

Of course, even for that argument—namely that altruism in the West is not prevalent—several counter-arguments can be made. For example, the whole notion of giving to the ones in demand, a concept strongly advocated by Christianity, is intrinsically associated with the advanced societies of the West. Contemporary examples are the widespread existence of various charity organizations, and even the existence of several campaigns targeting the disadvantaged populations of today’s world. Voluntary giving constitutes an integral part of Western culture.

Besides this interesting link between the COMT gene and the onset of behavioral patterns, such as the "warrior vs. worrier" strategy, polymorphisms in this gene have also been associated with certain psychopathological and neurological conditions. These include Parkinson's disease (PD), at which the low-activity allele (A) was associated with increased risk for PD (Kunugi et al., 1997) and others, such as homicidal behavior in schizophrenic patients (Kotler et al., 1999) or obsessive-compulsive disorder (Karayiorgou et al., 1997). These are all pathological behaviors. Interestingly, in the latter study the corresponding association was more pronounced in the males. Noteworthy, in all cases the allele associated with pathology was the low-activity allele (A) that encodes for the amino acid Met. This is also the allele that is related to the worrier behavior, and is more prevalent to Westerners.

So, it appears that the benefits conferred by the Met allele that were related to the increased ability of individuals to function efficiently under complex conditions were compensated to some degree by a sensitization against certain pathologies. This reminds the "no good without bad" dualistic principle that is seen in various philosophies, and which range from the Yin-Yang Taoist principle to the teachings of Augustine, who claimed, "Nothing evil exists in itself, but only as an evil aspect of some actual entity."

In the case of COMT a possibility is that when the structure of social organization increased in complexity following the individualistic cultural line, individuals with the Met polymorphism had an advantage that was associated with the benefits conferred by the development of a "worrier's" behavior. An unavoidable consequence, though, was the predisposition to certain pathologies, such as PD and obsessive-compulsive disorder.

10. Leaders and Followers

During the earliest periods of human history, and concomitantly with the development of hierarchical societies, certain individuals acquired a leadership role by guiding other people (the followers), obtaining a role surpassing that of their single existence and probably immediate family and taking responsibilities on matters involving a larger cohort of people or the group they belonged to. This role was reinforced by the political and social system by powers that at some times were based on metaphysical and at other times on more rational (usually in cases of democratic societies) concepts and arguments. Even before the emergence of these societies, during the tribal organization of *Homo sapiens* , certain individuals functioning as leaders were present, but with the corresponding administration being simpler, while both the criteria for establishing leadership and the responsibilities of the leaders were narrower. Thus, it is self-evident that the emergence of leaders played a major role during human history, and that the qualities of such leaders, as well as a genetic tendency to that behavior, would be of particular interest.

Cholinergic receptor, nicotinic, beta 3 (CHRNB3) belongs to a family of receptors that mediate fast signal transmission at synapses. A polymorphism is located in the 5'-untranslated region (DNA sequence that is not translated into protein) of the corresponding gene designated as rs4950. The polymorphism refers to the presence of either G or A, and although it does not affect the primary sequence of the CHRNB3 gene, and thus of the corresponding receptor, it may affect its regulation and therefore its activity. This hypothesis is supported by the fact that adjacent to this position, several regulatory genetic elements have been identified. Earlier studies have provided evidence for a potential association between CHRNB3 polymorphisms and subjective responses and dependence to tobacco (Bierut et al., 2007; Saccone et al., 2007; Zeiger et al., 2008).

Besides this association of CHRNB3 and smoking habits, another intriguing observation is related to the geographical distribution of the rs4950 alleles. Table 6 shows the frequencies of G and A alleles in the polymorphism rs4950 in various populations around the world, according to the HapMap project.

From these data, it is readily observed that all populations outside Africa, such as Asians, Europeans, Mexicans, and Indians, have high frequencies of the A allele. This frequency is greater than 0.7, which means that this allele corresponds to about 70% of all alleles in these people, as compared to below or around 0.3 or 30%, which is the frequency of the same allele in the African populations tested. The latter populations included representative samples from the Yoruban, Maasai, and Luhya, [23] as well as people with African ancestry living in the U.S.A.

Given the role of CHRNB3 in neural function, and thus its likelihood to affect behavior and decisions, one could have argued that this specific polymorphism is likely to regulate migratory behavior: Populations that resulted from migration events (essentially all people outside Africa) have a high frequency of the A allele while African people, who apparently did not have to perform long-distance migrations from their original location in Africa, have a lower frequency in the A allele and a higher frequency of the G allele. Thus, the A allele may contribute to the acquisition of a migratory behavior by either inducing the decision to migrate or by offering an advantage to the people that have migrated.

This possibility could have been related to a rather intriguing hypothesis, namely attributing to the CHRNB3 gene polymorphism the function of the ultimate migration gene, surpassing a similar role discussed in earlier chapters for the DRD4 gene. Unfortunately, though, besides this superficial observation, no technically and statistically sound scientific studies—as yet, at least—are there to support this notion.

What has been reported is another interesting association between the rs4950 polymorphism and the emergence of leadership behavior. Specifically, individuals bearing the A allele were more likely to show leadership potential as compared to the G-allele-bearing individuals. Noteworthy, this report comes from the same investigators that earlier

reported the interesting association between DRD4 and liberal political beliefs, namely Christakis and Fowler (De Neve et al., 2011), who found that the A allele of rs4950 is associated with leadership.

In this study, among the various scientifically acceptable ways to measure leadership, the investigators decided to use the occupancy of office associated with leadership as the actual measurement of leadership, which defines it in terms of formal and informal leadership roles that individuals maintain in their workplace.

Table 6 *. Frequencies of rs4950 polymorphism (G/A) in the CHRNB3 gene in different populations according to the HapMap project.*

Population	**G allele frequency**	**A allele frequency**
African ancestry in Southwest USA	0.728	0.272
Utah residents with Northern and Western European ancestry from the CEPH collection	0.226	0.774
Han Chinese in Beijing, China	0.277	0.723
Chinese in Metropolitan Denver, Colorado	0.202	0.798
Gujarati Indians in Houston, Texas	0.238	0.762
Japanese in Tokyo, Japan	0.128	0.872
Luhya in Webuye, Kenya	0.798	0.202
Mexican ancestry in Los	0.155	0.845

Angeles, California		
Maasai in Kinyawa, Kenya	0.689	0.311
Tuscan in Italy	0.173	0.827
Yoruban in Ibadan, Nigeria	0.844	0.156

Their approach was rather autobiographical and the ultimate question that they asked to the participants of their study was: “Thinking about your old job duties, which of the following statements best describes your supervisory responsibilities at your (current /most recent) primary job?” The potential answers included the following: “I (supervise/supervised) other employees” or “I (do/did) not supervise anyone.” Initially, by analyzing monozygotic and dizygotic twins, the investigators provided evidence that genetic factors play a role in the emergence of leadership, and then they proceeded to the genetic association studies by which they identified marker rs4950 as a candidate for leadership. Finally, they confirmed their results in a different, independent population, which adds particular validity to their arguments and conclusions.

Their findings are in line with the role of CHRNB3 in the regulation of the dopamine system, especially in view of the recognized role of this neurotransmitter in regulating behavior, although, as they recognized, a lot of additional work should be done in order to understand the neurophysiologic basis of these genetic linkage findings.

Taking the aforementioned association between rs4950 and leadership as a fact, the observation that the A allele is much more common outside than within Africa may also be viewed as a finding that is in line with the fact that the establishment of complex societal structures in the “out-of-Africa” populations, by definition, requires more (but probably not too many) individuals with leadership tendencies and capabilities. These potential leaders would have operated as such, at the original political, military, religious, economical, or any other aspects of the emerging societies. And the fact is that the more complex the societies are, the more “leadership” positions are developed and needed. By looking at the genotype data (the

distribution of the A and G alleles in the individuals) for the same populations described in Table 6 , we notice that an excess of AA individuals (both leadership alleles are present) exists (Table 7). Thus, more leaders than followers are present in these societies, an observation that contradicts the fundamental notion that in such hierarchical structures, leaders are less than the ones they will lead (the followers).

A likely explanation is that a leader in one domain of life is a follower in another. One can be—and most of the times actually is—a military leader and an economic follower at the same time, or concomitantly a political leader and a religious follower. This way, the attraction and tendency for leadership of the most possible people are being satisfied, the society operates smoothly, and turmoil is minimized. A fellow scientist, apparently with quite high self-esteem, once told me that if he was to be recruited for the priesthood, he would have been a pope by now! It's not uncommon to meet someone outside the context at which we recognize him as a leader and realize that he functions as an ordinary follower.

Various exceptions to the rule exist and certain individuals, especially during specific historical periods, have accumulated leading positions beyond a single domain of life. Thus, at the same time we see leaders in religion who also hold high political and frequently military offices as well. And not that uncommonly, they were extremely rich at the same time! Such social and political structures, of course are currently viewed as oversimplistic and dangerous, and that they reflect less-advanced types of societal and apparently political organization. The current trend is towards diversification. Military leaders are distinct from the political or religious leaders, while crosstalk with the economical elite is considered at least suspicious.

Naturally, a positive feedback may operate between leadership and complexity: The existence per se and probable abundance of individuals with a tendency and desire to become leaders may not be just a simple result but might have also fueled the foundation of such complex societal structures that require many leaders to function properly. To that end, the leadership "demands" of an increasing number of individuals must be satisfied, and thus, the elevated complexity of the structures might have

been necessary in order to generate various leadership niches sufficient to accommodate all prospective leaders.

Consistent with that notion, it is possible that building complex structures in all aspects of life is not a simple and sole requirement dictated from the advances of culture and civilization, but also an intuitive strategy that unconsciously aims to satisfy the peoples' endogenous demand for leadership. More "leaders" found more complex societies that, in turn, require more leaders to function. Besides the social complexity, this interconnectivity also increases the cohesive bonds between individuals in a society, and thus, in part may compensate for the potential "deteriorating" consequences of individualism. As it becomes apparent, a positive regulatory network is being established between complexity and leadership at which the occurrence of one is not only a perquisite for the other but also induces it.

Another interesting issue is the potential link between rs4950, leadership and migratory behavior per se. An interesting explanation for this link can be that migratory populations definitely demanded leaders. The success of these migratory waves was largely dependent on the abundance of people who could lead successfully both the expedition as well as the first communities that were established in the new territories. The more individuals who could be the leaders in such expeditions, the higher the chances for success for these newborn societies .

Table 7 *. Frequencies ofrs4950 genotypes in different populations according to the HapMap project.*

Population	AA	AG	GG
African ancestry in Southwest USA	0.088	0.368	0.544
Utah residents with Northern and Western European ancestry from the CEPH collection	0.602	0.345	0.053
Han Chinese in Beijing, China	0.533	0.380	0.088
Chinese in Metropolitan Denver, Colorado	0.642	0.312	0.046
Gujarati Indians in Houston, Texas	0.564	0.396	0.040
Japanese in Tokyo, Japan	0.752	0.239	0.009
Luhya in Webuye, Kenya	0.046	0.312	0.642
Mexican ancestry in Los Angeles, California	0.707	0.276	0.017
Maasai in Kinyawa, Kenya	0.096	0.429	0.474
Tuscan in Italy	0.663	0.327	0.010
Yoruban in Ibadan, Nigeria	0.048	0.218	0.735

Furthermore, these leaders frequently were quite successful, reproductively speaking, since they represent good mating partners for cultural and other reasons. Thus, their genes were likely to be “over-represented” in the subsequent generations. In view of these observations, it is not that surprising that the leadership-associated allele of rs4950 is over-represented in all human populations outside Africa and under-represented in the African people.

11. Eastern versus Western Traits are “En Bloc”

We have seen only a few of the genetic traits that might affect human behavior. Furthermore, we were able to see that the frequencies of the corresponding polymorphic alleles differ between people of the major human cultures, namely those of the East and those of the West, or people of Chinese or European origin. Analogous differences, but at a smaller scale, also exist between other ethnic groups, but by comparing the two extremes, would likely be more informative in order to extract some interesting conclusions. Countless additional studies are also available in the scientific literature that either associate these particular loci to the regulation of various other behavioral traits or implicate loci other than those we have discussed in the regulation of human behavior. At this point, expanding the description and the analysis to additional traits and attempting to cover more genetic loci is probably useless, and it will only complicate things. However, some interesting points can be made.

Let’s summarize here what we have seen until now:

First of all, among the various polymorphic genes that exhibit a relatively characteristic geographical distribution, namely differing in their frequency between East and West, at the same time also affecting certain behavioral traits, we have discussed DRD4, HTT, MAOA, and COMT (Table 8).

Among the various different versions of these genes, the ones that are more common to Westerners have been associated with increased novelty-seeking, nomadic life, distance of out-of-Africa migrations, a tendency for financial risk-taking, and liberal ideology (DRD4). On the other hand, the various versions of MAOA and 5-HTT that are more frequent in the West predispose for collectivistic behavior, and as regards 5-HTT, this same

version of the gene also increases the likelihood for someone to be happy with his or her life.

Finally, the version of COMT that is seen frequently in the West predisposes for the "worrier's" as opposed to the "warrior's" behavior. In addition to those genes that have a "West versus East" geographical distribution, certain polymorphisms of the CHRNB3 gene are more common in all populations that are presently out of Africa, as compared to the populations in Africa, and also predispose for leaders', as opposed to followers', behavior .

Table 8 *. Examples of major behavioral traits that likely affect the development of Eastern and Western cultures and potentially have a genetic basis.*

Trait	**Gene**	**Allele frequency**
Novelty seeking	DRD4	7-repeat novelty seeking allele more common in the West
Migration	DRD4	7-repeat allele is associated with distance from Africa migration
Nomads/settlers	DRD4	7-repeat allele is associated with nomadic life
Political ideology	DRD4	7-repeat allele is more common in liberals
Financial risk taking	DRD4	7-repeat allele is more common in risk- takers
Individualism/ Collectivism	HTT	s allele (collectivistic) of 5-HTT is more common in the East

Happiness	HTT	l allele has higher prevalence in individuals happy with their life
Individualism/ Collectivism	MAOA	3-repeat allele (collectivistic) more common in the East
Warrior/Worrier	COMT	A-allele (worrier) more common in the West
Altruism	COMT	G-allele (warrior) associated with altruism
Leader/Follower	CHRNB3	A-allele (leader) more common in populations Out-of-Africa

An interesting observation from these results is that it appears that these independent polymorphisms appear to "fit" together quite well in shaping someone's personality. In other words, we can identify a short of "complementation" and synergy between the various traits contributed by these polymorphisms seen in the same population. For example, it is more likely for a novelty-seeker to exhibit individualistic behavior, rather than collectivistic. Being a novelty-seeker ultimately means committing to a constant process that aims to satisfy one's individual needs, an attitude that is intrinsically related to individualism. The same applies for the political ideology at which being a liberal "fits" better with being individualistic rather than collectivistic in his or her behavior in the perception of life. Liberal as opposed to a conservative ideology may imply that someone wants to alter a certain status quo that in turn is usually intrinsically linked to an established balance and harmony in a society. In that case, the individual needs (the needs of the individuals) have been displaced by those that benefit the society as an entity. Not of course, that this balance is already the best possible, but it is still capable of offering the security of belonging to a specific group. Furthermore, the process of this change and alteration, as such, possesses a component of risk-taking against a speculative novel status that is unknown as yet, and thus, poorly defined. In

addition to those tendencies, being a “worrier” as opposed to a “warrior” means that someone has the ability to adapt at the complex conditions, which are usually the conditions faced by the novelty-seekers in the new environments they have to face and deal with. This is also analogous to the liberal ideology at which the complex process of change, as such, in general, requires the ability for adaptation in such novel conditions, which in turn is benefited by the “worrier’s” behavior. The association between having a tendency for altruism and collectivistic behavior is also self-evident, since the benefits of altruism become apparent only in societies with an increased collectivistic component. On the other hand, a worrier that is characterized by reduced impulsivity, as compared to the warrior, is likely less altruistic, since strictly speaking, the latter attitude does not satisfy directly his or her individualistic needs. As we have discussed, an individualist behaves altruistically only when the benefits of such behavior are visible. In that sense, he is an altruist by a manner that is individualistic (!).

An interesting exception, at least if we view things quite superficially, to those observations is related to the association of the happiness allele of 5-HTT with the polymorphism that is more frequently seen in Westerners. The “change”—associated trends of novelty-seeking, liberal behavior, or risk-taking, and even that of the “worrier’s” behavior probably contain, in a latent status, the component of dissatisfaction. If you want to change things, it means that you are not satisfied with what you have already. That, in turn, may correspond to unhappiness. Consistent with that view, it is hard to understand how one is happy with his life and at the same time seeks to change it. Moreover, his willingness to take risks for that change increases his potential dissatisfaction even more. As already discussed, though, it is possible that either the same exact component of change is the one that contributes to the perception of happiness, or some other benefits of this “happiness”–associated polymorphism, such as the stimulation of individualism that is also associated with 5-HTT—are the ones that prevail. In that case, of course, we reach the surprising conclusion that the “default” and spontaneous condition is not that of happiness, but the latter emerges as a side-consequence of other benefits conferred by the corresponding polymorphisms. You have to be happy because, in principle, you are an individualist!

Despite those peculiarities, an unbiased conclusion that can be reached is that the sum of the aforementioned polymorphisms and the corresponding behavioral trends they control appear to fit together quite well. In other words, they appear to behave "en bloc," which implies a certain degree of complementarities in shaping up the major Western and Eastern cultures and the archetype personalities of the corresponding people.

It has to be noted that such a notion is different from the genetically defined and measurable linkage, according to which two genes, or genetic loci, by being closely located in the same region of the chromosome, are inherited together. Thus, we may see that the physiologically irrelevant trait A and trait B are frequently seen together, just because the corresponding genes controlling them are closely located in the same chromosomal region.

In the present case, though, the genes discussed earlier, which are controlling these behavioral traits, are located in different chromosomes and/or distal chromosomal locations, and thus, no genetic linkage may have occurred. Of course, genetic founders'—related phenomena that are associated with the original shaping of the genetic structures of the corresponding populations—have naturally occurred. In that sense, what we witness today is just the reflection of the original genetic composition of the people that inhabited the corresponding areas at the first instance. But even in view of that fact, that the corresponding behavioral trends are related is interesting.

A plausible explanation is that pure randomness (or coincidence), supplemented with a specific dose of relativity, contributed to this observation. What we see as reasonable and logical now is the collective outcome of a given, continuous, and distinct process that has already shaped our mind accordingly in order to make us view things in a certain way: The reasonable way! Our civilization has pre-defined our way of thinking to interpret certain and specific attitudes (and actually whole sets of attitudes) as reasonable. To that end, it is quite hard for us to imagine that an alternative—and not simply the "opposite," consistently with Eastern-Western dualism—cultural line and behavioral pattern could exist and be functional. It is the same difficulty we have as lay people and not theoretical physicists in understanding worlds and phenomena that operate in five or

six dimensions. And, indeed, the more isolated intellectually we are, the higher the difficulty to perceive such alternative possibilities is.

In theory, if we were able to have large populations at which these combined traits, such as both Westerners' novelty-seeking allele of DRD4 and Easterners' collectivistic allele of HTT, represented the majority, it might have been quite informative. It would have allowed us to observe the features of the corresponding cultures and whether they would have become an interesting hybrid between what we currently perceive as East and West or a novel, third- and fourth-type culture, distinct from the aforementioned two (Figure 7). In that latter case, of course, the whole concept of the dualistic perception deeply carved into our minds would have suffered from severe damage.

Consistent with such a hypothetical scenario, it would be even more interesting to look at what we understand as "en bloc." Would the corresponding traits, in such a case, still feel like they fit well together ?

Certain subpopulations, though, and groups of people within these major populations, do exist. The frequencies of the polymorphic sites are not absolute—neither 100% or 0—for any of the traits we discussed earlier. Actual frequencies are between these values and, thus, all possible combinations occur.

Thus, the Westerners' novelty-seeking allele of DRD4 and the Easterners' collectivistic allele of HTT do co-exist in many individuals. The only difference is that, since in the West the novelty-seeking and individualistic alleles are at a higher frequency, the chances to co-exist are higher; thus, the number of these individuals is greater. However, the fact is that such people, with combined Eastern and Western traits do exist and are actually integral parts of these cultures that are dominated–in quantitative aspects–by the "en bloc" traits .

That the individuals with "combined" traits are just the minority likely masks their inherent and potentially distinct features. In other words, since it is the majority that makes the rules and defines the social norms, these low-novelty-seeker individualists, or high-novelty-seeker collectivists, by

being a minority, miss their chance to make their point and leave their cultural fingerprint by establishing a distinct cultural trend-line.

Another possibility is that the “en bloc” characteristics we observed indeed helped the diversification of these cultures. There is a certain theoretical possibility that the result is not due to quantitative but rather qualitative processes. To that end, cultures developed by such “hybrid” populations, with “mixed” (the Easterners’ and Westerners’) predominant traits (for example, by being concomitantly novelty seekers and collectivists), might have been unstable, and eventually they might have been absorbed by the cultures that exhibited the corresponding characteristics “en bloc.” We may understand that by considering a society that is dominated by such novelty-seekers and collectivists. These individuals that represent the majority in these populations will constantly have to compromise the risks associated with the novelty-seeking behavior with the stability of the collectivism. The continuous compromise of these opposite tendencies is possible that might have nurtured a conflict. It is quite likely that, in the long run, such conflict would not have survived. Imagine, for example, that at a period of a certain massive disaster that required the advantages of collectivism, the society would, at the same time, also have to cope with the needs of the majority of individuals, being the risk-takers and novelty-seekers (that also display a tendency for liberalism). This state would probably have been contradictory, suffering from some kind of intrinsic instability.

Imagine another hypothetical society at which the majority is composed of individuals that at the same time are individualistic but not novelty-seekers. As individualists, they’ll have to pursue happiness in view of the needs of the single person. But without being capable of taking certain risks and being novelty-seekers, their capacities will be limited, and such societies would not have advanced at a degree comparable to that of the societies with these traits “en bloc.” Individualism would not be able to function smoothly and efficiently in the absence of a tendency for novelty-seeking. The intrinsic need for being different from the others, which is an integral component of the individualistic societies, in order to be satisfied, requires the tendency for novelty-seeking and risk-taking, as well as a certain degree of liberalism within the context of the doubt of the existing

"status quo." In financial terms, this is analogous to the widely accepted notion that economic stability depends on growth.

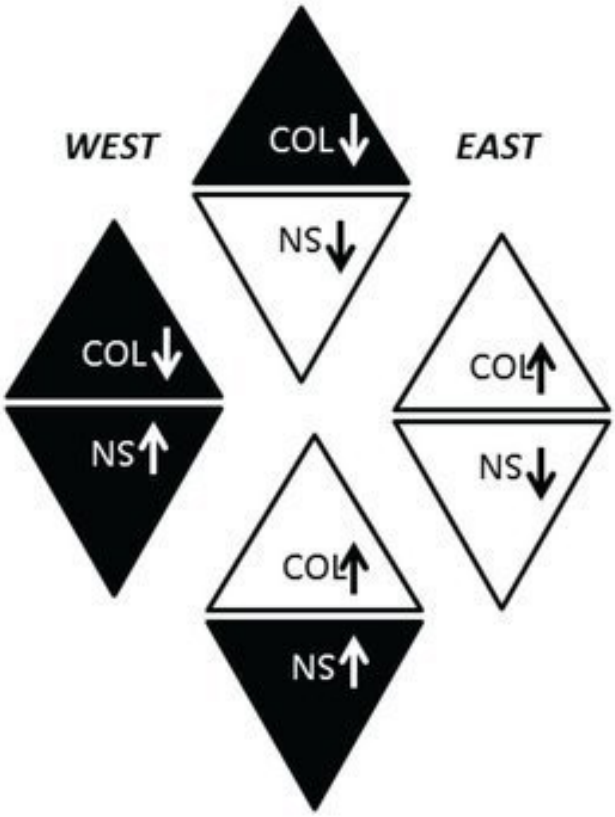

Figure 7 . This diagram depicts the "en block" traits collectivism (COL) and novelty-seeking (NS) in the East and the West. The upper and lower panels depict mixed populations at which high collectivism is accompanied by high novelty seeking and vice versa, low collectivism is accompanied by low novelty seeking behavior. It is noted that that neither collectivistic nor novelty seeking societies

Even if such societies existed (Figure 7), we may anticipate that in the long run they would not have been as successful as the ones at which the aforementioned characteristics existed "en bloc." Probably, the subpopulations with the corresponding characteristics presented "en bloc" may have eventually prevailed, resulting in societies that simulate the dualistic present-day Eastern/ Western discrimination.

Of course, another important point that needs to be made is that despite that such individuals with “combined” traits represent the minority in both the East and the West, they still contribute significantly to the intellectual and behavioral variability of the corresponding populations and cultures, a condition that is imperative for their advancement. Another intriguing possibility is that, indeed, populations and associated cultures with such mixed characters existed in the past, but they might have been eventually absorbed by these major Eastern and Western cultures that dominated human history. To that end, by definition, they were classified in relation, and actually in between, these two extremes.

PART 3

PERSPECTIVES

12. On the Fluctuations and Oscillations of Behavioral Trends

Regardless of the exact mechanism that operated during these extremely large-scale processes, which involved large groups of people and whole populations, various interesting predictions and some testable hypotheses can be made, based on the aforementioned notions. Let's focus at first on the *s* and *l* alleles of DRD4 that are associated with collectivistic and individualistic behavior. Since this behavioral pattern appears to play a major role in the distinction between Eastern and Western cultures, it represents a good paradigm in order to attempt a speculation on possible future trends. Analogous considerations can also be made for all other polymorphic genes described earlier, especially if we view them according to the concept of being "en bloc."

From time to time, certain epidemics have occurred in different regions of the world, such as the plague of Athens around 430BC. According to a recent DNA analysis, it was attributed to typhoid fever (Papagrigorakis et al., 2005). Consistent with our previous discussion on the protective consequences and advantages offered by the collectivistic behavior, we may postulate that such epidemics operated as bottlenecks that have enriched for the *s* allele in the corresponding populations, a fact that in turn may have boosted collectivistic behaviors (or vice versa, since collectivistic behavior offered an advantage, it favored the *s* allele-bearing individuals).

Theoretically, the extent of such bottlenecks could have been recorded and calculated. If we were able to obtain DNA from representative groups of individuals dated prior and after such catastrophic events, and assess the frequency of the *s* and *l* alleles, we might have been able to monitor those

sequential increases and decreases in the *s* allele's frequency, that transiently favored collectivistic behavior in otherwise individualistic societies [24] : Each time such an epidemic had occurred, it is conceivable that among the people that died, the ones with the *l* allele are more likely to do so, since they are devoid of the beneficial and protective effects of the *s* allele. Or, alternatively—and more likely, actually—the ones with the *s* allele, since they were able to adapt more efficiently into the new conditions during the crisis or the ones that followed the crisis, were likely able to produce more offspring. So, it is anticipated that following completion of such a cycle of the epidemic, the *s* allele's frequency would have increased and, probably, the higher the increase, the stronger the selective pressure and, ultimately, the higher the benefits of the collectivistic behavior in this particular case. Apparently, that crises induce collectivism in individuals is something we have all experienced. In the end, the individuals that can do this more efficiently, namely, alternate from individualism to collectivism, will become more successful. And by extrapolation, the populations at which the change between collectivistic and individualistic tendencies is more efficient will also be more successful. This reflects the fundamental knowledge according to which survival is quite strongly associated with adaptability and plasticity. To that end, we may understand the presence of relatively high genetic variation among a given society, and the presence of available polymorphic alleles as a safety valve that warrants survival and prosperity in a given society.

In an opposite scenario, in people of collectivistic cultures, we may expect that prolonged periods of "prosperous" living, at the level of several generations, without disastrous phenomena (not only natural) of any kind that are associated with crises that otherwise could have favored collectivistic behaviors and restrain individualism, might stimulate the enrichment of the *l* alleles, at the expense of the *s* allele's frequency. Whether in that case the *l* -allele-bearing individuals (and the corresponding behavior that is associated with that) would have been offered an apparent advantage or rather the advantage of the *s* allele "collectivistic" individuals would have been diminished, giving the chance for phenomena associated with random genetic drift to prevail, is unclear. Anyhow, nowadays the reduction of the prevalence of such disastrous phenomena, and especially epidemics, is more likely to occur and is also favored and facilitated by the

advancement of science, technology, and medicine that reduce the negative impact of these events. Thus, under these conditions of prosperity and harmonious co-existence of people during periods that are devoid to major catastrophic events, individualistic behavior is favored, and this may result in the enrichment of the allelic frequency of the *l* alleles.

Historical experience during the twentieth century showed clearly that totalitarian political regimes—which can be viewed, in some extreme sense, as the ill reflections of collectivism—are quite likely to occur after prolonged periods of depression, conditions that induce fear, and share certain similarities with periods at which epidemics and catastrophes may have occurred. This does not necessarily mean that totalitarianism should be strictly related to the communist systems that appeared in Europe, especially during the second half of the twentieth century. Those systems actually claimed that, for them, the development of collectivism represents an essential purpose and the means for a population's prosperity. However, even in societies and in economic-political systems structured on the basis of Western-type individualism, the main elements of such collectivism can be identified. Such an example can be recognized in the emergence of Nazism in Germany that followed the Depression just after the First World War. In that case, the benefits of collectivism for the individual people were found in the inclusion in a political party, a fact that in turn provided a socio-political and financial niche. In any case, following some prolonged crisis, people appear to rediscover the benefits of collectivistic behavior.

Naturally, as someone may have well anticipated, harmonious living is not likely to occur forever, especially in groups of people that are devoid of collectivistic norms. Conflicts of interest are intrinsic to societies that are prone to individualistic behaviors and at which the well-being of a single person has been dissociated from (and occasionally opposes) the well-being of the others. The fact that Western societies desperately try to build a collectivistic conscience advocating the values and benefits of belonging into a greater group of people does not contradict but rather reinforces and supports their individualistic orientation (and predisposition). Caring for the neighbors and generally for others, by being active members of the society, and by supporting the ones in need among the group of people that we feel we belong to, likely reflects the fact that such collectivistic notions are

imperative in order to be able to function as a single social entity. To that end, such collectivistic notions operate as the cohesive bonds of our societies. Of course, we should never forget that nobody is absolutely individualistic or collectivistic at the same time, and this is applicable at an even larger degree to whole groups of people composed of individuals prone to either individualistic or collectivistic behavior. Besides the requirement to generate the appropriate norms and bonds that will facilitate our function as a society, each individual also has the need to satisfy his collectivistic instincts. Thus, a collectivistic mentality is being progressively built, without, of course presenting an imminent danger to the dominant individualistic norms of the society. The opposite, of course, applies to the collectivistic societies that apparently are not completely devoid of individualism. It is just a matter of the cumulative balance and towards where it is shifted, in either case.

Crises, however, ignited either extrinsically or intrinsically, are eventually unavoidable, and in turn, the socio-environmental conditions at which collectivism will again flourish are unavoidable. An attempt to diagrammatically present this is shown in Figure 8 . This is an oversimplified summary of the ideas presented here.

We pose that collectivistic or individualistic behavior is not a straight line, but rather a wave-like line at which peaks are followed by troughs, and recession periods are followed by recovery periods. The vertical axis represents the “strength” of the individualistic or collectivistic behavior that, in turn, can be translated in allelic frequencies in the corresponding populations.

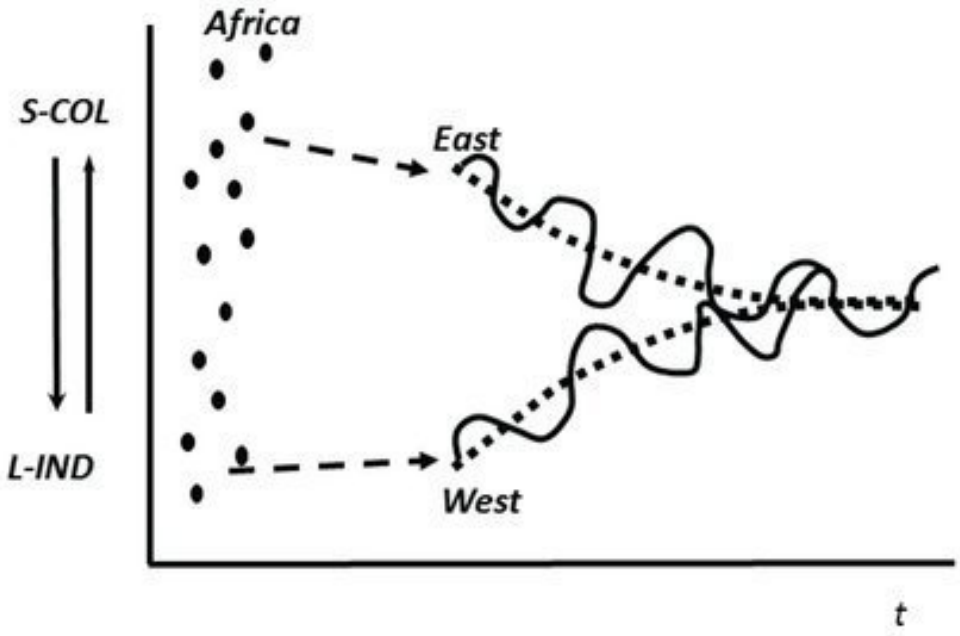

Figure 8 . The diagram shows a possible trend for the allelic frequency of s and collectivistic behavior (COL), or the allelic frequency of I and individualistic behavior in the East and the West. The x axis indicates historical time while the vertical y axis the degree of collectivism/individualism that is presumably analogous to the frequencies of s/i alleles in the corresponding populations .

According to this very simple hypothetical diagram, everything started again in Africa, about a hundred thousand years ago, when originally these polymorphisms, the *s* and *l* alleles in particular, had already been generated and stabilized in specific subpopulations. Then, small groups of people started migrating out of Africa, already having different frequencies in the corresponding alleles. Then, these alleles either because of the advantages they offered, or because of the genetic drift, or even more likely because of a combination of both, were stabilized in the resulting populations that eventually occupied different regions of the world.

Subsequently, depending on the potential advantage they did (or not) offer to these populations, they started becoming enriched (or replenished), while the corresponding people that “happened” to occupy Eastern Asia or

Europe started developing cultures that exhibited the earliest evidence of collectivistic or individualistic behavior, as we know it and record it today.

Naturally, the corresponding allelic frequencies did not remain stable but changed over time. This change could have been due to random events, responses to external effects and changing conditions, or migration from and more importantly towards these populations. We may imagine, though, that each individualistic peak was, and actually still is and will be, followed by an eventual recession that occasionally is signified by a type of catastrophic event of sufficient power and magnitude to ignite a boost in the collectivistic behavior. We can also speculate that if such periods are quite prolonged and at least greater than the duration of a single generation, then they will also dictate analogous changes in the *s* and *l* allelic frequencies that, in turn, will affect behavior even more. Such fluctuations are very common in real life and can be seen in the natural physical phenomena, such as the temperature and CO_2 emissions, to blood pressure and animal populations, and even to the stock market. That the projection of these lines exhibits a decreasing or increasing trend for Easterners or Westerners will be discussed in the following chapter.

13. Trends

Given the role of *s* and *l* alleles in regulating peoples' behaviors related to an individualistic or collectivistic tendency, a reasonable question is on whether we can predict a future trend that involves these perceptions of life and society. The answer to that question is no. These phenomena are too complex and multi-factorial to be predicted at some level of acceptable scientific accuracy. The intrinsic and extrinsic variables are too many to calculate their contribution in the specific outcome that we are attempting to quantify and interpret. There are, however, a few specific parameters that we may consider as quite likely to occur, and therefore make an "educated guess" regarding possible trends.

First of all, isolated populations are less and less likely to exist, not only physically, but also culturally, economically, and intellectually. We frequently call this trend *globalization,* and as a state it has many proponents and opponents. No matter, however, if this is good or bad, the fact of the matter is that it is unavoidable. It's happening more and more intensively, and the overall "size" of the world in which the future generations are going to live will be smaller than the one we live in today. By that we mean that people tend to live in a single global community instead of several, relatively isolated sub-communities. We can understand its consequences in all the attributes of our everyday life. At the cultural and probably intellectual level, turning the television on is a simple action that is sufficient, though, to show how people live and think at the other end of the world. And this doesn't remain as purely academic information, but has immediate consequences for the everyday lives of people. The effect of American television series in Indian women represents a quite characteristic example: Where various attempts to liberate women, by the introduction of specific laws and regulations, failed, Western television serials have succeeded (Levitt & Dubner, 2009). And this, in turn, had significant consequences on the structure of Indian society. Countless analogous

examples can be described at this point on the effects of television all over the world .

Whether we, as inhabitants of a specific geographical area, live better or worse than other people, either closely or remotely located to us, today it is easy and straightforward to find out. And while with the television we can only receive information, with the revolution of the Internet we can also interact (culturally and financially) with these remotely located people. So now, the norms of our society are not being established only by our family, our schools, the formal educational system, and in general the social environment that is physically in our close vicinity and at which we belong, but also by people that can be located physically far away from us. It's the global village idea (McLuhan, 1962), which makes iPads quite compatible with the chadors and the sushi bars and an intrinsic component of the basements of several multinational corporations (and in which Eastern Asians may not necessarily work). Our cultural environment is not defined only by what we have inherited from our ancestors combined with our own contributions to a defined society (that contains us), but also by inputs we continue to receive from remote cultural locations.

Naturally, such external influences by other cultures have always represented a characteristic that occurred constantly during the history of all cultures. Traditionally, it was the merchants, the soldiers, or other individuals that usually, because of their jobs, were able to interact with populations far away from their home countries and who had received or transmitted cultural elements. The difference now is that the flow of information is not sporadic and occasional, but rather continuous and bidirectional, and cannot be reduced to specific groups of people that, as travelers, act as the carriers of this information. Following the "discovery" of China by the West, an extensive exchange of goods and cultural attributes was initiated. However, the corresponding cultures and societies were well defined, while the "self-sufficiency" of the corresponding cultures was not at risk. The exchange was limited to specific merchants, missionaries, and other defined groups of people. What products or ideas that were to be exchanged were not only limited quantitatively, but were also and unavoidably "filtered" before they reached the individuals who were receiving it. So, its effects were relatively limited and specific. As

opposed to that pattern, today's flow is continuous, multidirectional, and uncontrollable.

In financial issues, the inter-dependability of the world's economies is even more apparent. The recent financial crisis in Greece has attracted a lot of attention from the international media, the world's leaders, and ordinary people all over the world as well. This is not simply because the rest of the world suddenly started to worry about the quality of life of the Greeks, which was becoming worse, but rather because of the fear of the ignition of a domino of collapse in the world's economies. The global consequences of the bankruptcy of the Lehman Brothers investment bank in 2008 provide a good recent example of this global interconnection and interdependence. It's the butterfly effect, [25] according to which the flapping of the wings of a butterfly at the one end of the world can cause a hurricane at the other end of the world!

Another emerging issue of modern times is the progressive reduction of physical isolation among people of different regions of the world. Migration always existed throughout the history of mankind, and therefore the exchange of genes (alleles) was happening. Since no populations (of considerable size) were absolutely isolated for considerable time, gene flow had always occurred [26] . Mostly, those exchanges involved historically defined movements of groups of people of which their relocation was tightly related to specific natural phenomena and needs within a given historical context. It could have been famine, political oppression, slave trading, or specific natural phenomena (disasters) that forced, motivated, or ultimately persuaded people to relocate and seek a new homeland. Moreover, they refer to a defined group of settlers that either occupied a previously unoccupied region or entered a region that was occupied by another, local population with which the migrating population eventually intermixed. The genetic pools, though, were relatively well defined, despite the fact that these pools were never isolated. Intermixing did occur but at more reduced rates, especially when this involved genetically "distal" populations. In other words, the "moves" (of people and genes) were tractable and historically recordable. And even in the cases in which more extensive intermixing occurred, the resulting population (as well as the populations from which the latter originated) was becoming again quite

well defined and distinct. Take as an example the massive waves of Spanish and Portuguese (along with their slaves) that inhabited South America. They interbred with the indigenous populations and the resulting, contemporary inhabitants of South America can trace their ancestors, to some extent, to these original populations (notwithstanding the fact that frequently and quite apparently the one's genetic signature predominates over the other's in different people).

Today, though, assisted by the increasing cultural interconnectivity, the exchange of genes is becoming easier between individuals of different populations and the genetic flow more unbiased and smoother. Thus, the global genetic pool tends to be unified, or in other words, to become a single pool with different densities in the allelic frequencies in particular regions. Within this greater population, the flow of genes will be more or less continuous (Figure 9). It is likely that allelic frequencies will tend to vary relatively smoothly with location, while cultural and other barriers will be less strict. [27] Moving and relocation of people from one place of the world towards another is becoming cheaper, more and more easy, feasible, and applicable. Of course, the trends are not the same and equivalent between opposite directions of such potential moves. At least during the current, specific historical period there are certainly more Chinese that want to relocate to the U.S.A. than Americans to China, or Pakistanis to Europe, than Europeans to Pakistan. But the fact is that continuous waves of immigration do occur that ultimately tend to result in some homogenization of the genetic pools. And this trend of homogenization will not only occur at the genetic level, but initially tends to occur at the cultural level, as well. At first, these immigrants tend to live in relatively isolated sub-communities in which genetic exchanges with outsiders are restricted. Subsequently, though, after a few generations assimilation is complete and genetic flow is unrestricted. No matter how massive these trend will be, phenomena related to the stratification of the populations progressively will tend to have reduced impact.[26,27]

Last, but not least, another characteristic of modern times is the progress in science, technology, and medicine that tends to reduce the impact of certain physical disasters and diseases. This becomes quite apparent as regards infectious diseases for which the overall improvement in the quality

of life and in sanitary practices, combined with the use of antibiotics and other potent medicines for which the access is becoming wider, renders the consequences of these diseases in the population less devastating, as compared to what was happening during the past times.

Of course, certain regions of the world, particularly in Africa, do not benefit from these advancements as much as other areas in the rest of the world, at least and hopefully not as yet. However, it is rather likely that given the increasing sensitization of the people around the globe, eventually these benefits will pass even to the people of Africa who, at present, seem to receive the smallest—if any at all—fraction of humankind's scientific and technological progress.

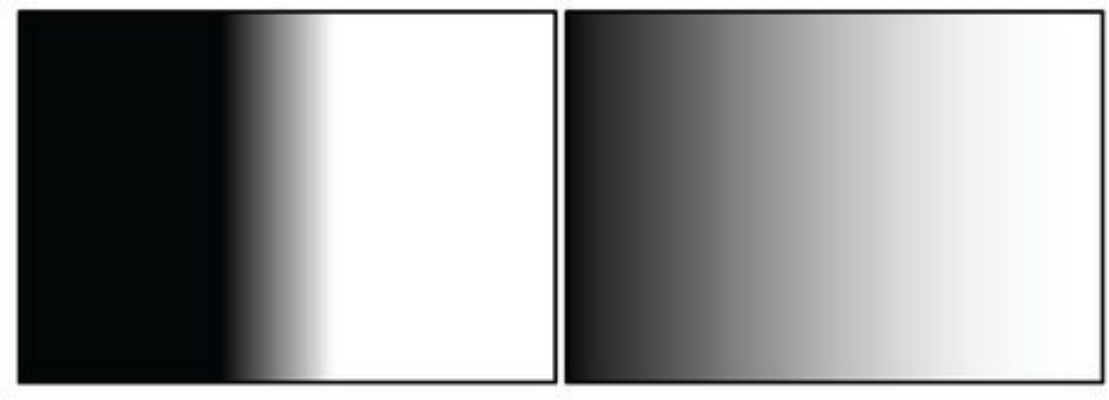

Figure 9 . A schematic diagram depictingthe difference between sharp (left) and smooth (right) changes in allelic frequencies (density of black or white color) in two populations at which genetic exchanges have occurred. In the left, the populations are relatively still well defined. In the right, the populations tend toward homogeneity. Presumably, the current global tendency is towards the right state .

Talking about conditions that endanger certain populations, it has to be noted that contrary to the beneficial consequences of science, technology, and medicine, a clear danger persists that has a magnitude that is by far greater than analogous dangers met by humanity before: It is related to the impact that wars may have today and are likely to have in the future. This is due to their capacity to be much more massive and devastating, as

compared to what mankind ever dealt with before. Indeed, while in past encounters the casualties were limited to thousands or tens of thousands (solders in particular), today the magnitude may be increased to the level of millions and even more. A not that ascertaining and comforting, genetically speaking, speculation, however, regarding this, is that while in the past they were targeting specific populations, and thus, genetic pools, the massive effects of today's and likely future wars will be less selective. Thus, their effects in altering the composition of specific genetic pools will be less pronounced than before!

Collectively, the fact that death from "unnatural causes," as we use to call them, becomes less and less likely in the days to come, the conditions that boost collective behaviors are going to be less common and frequent. In turn, and at the first instance, this reduces the advantages linked to these behaviors. Thus, the bottlenecks we speculated earlier are going to be less drastic and potent.

Keeping all these in mind, and for as long as the Easterner vs. Westerner cultural distinction continues to exist, we may be able to identify a trend for Easterners towards a more individualistic pattern. Of course, in that case, we have followed the "reverse" approach, according to which it's not the genes that dictate behavior but rather the socio-cultural (world's) environment that favors the specific behaviors that, in turn, may offer a long-term advantage to the individuals with specific genotypes. We can already see this at the cultural level, when we identify an increasing evidence for the invasion of elements from Western culture in the East, and it appears that this is much deeper than just a cultural trend. As already mentioned, and at the extent at which the present socio-environmental conditions no longer favor—at least not that much (!)—collectivistic behaviors, the latter become more vulnerable to individualistic attitudes. So, eventually they will be replaced by patterns and norms that are more suited to *l* -allele individuals. So, in Easterners, in the graph at Figure 8 , we may be able to identify a tendency for the reduction in the frequency of the *s* allele and the associated collectivistic behavior.

But what happens with the already-hardwired-for-individualism Westerners? It is conceivable that the predominant parameters that will

govern their future and fate are the following: The gradual infiltration of Western culture by Eastern values and norms may pull Westerners towards some collectivism. This is reinforced by the fact that currently, and likely for the years to come, Asians that immigrate towards the West are more, arithmetically speaking, than those exhibiting the opposite pattern of immigration, from the West towards the East. So the overall balance in such Western populations shifts towards some collectivism, at least in part due to their enrichment for "Eastern" *s* alleles. In addition to that, no matter how strong the efforts to transcend a collectivistic behavior in the people are, as it happens currently in the West, in order to preserve the ability of a group of people to function as a society, I doubt that this will ever be sufficient. Political, financial, and social crises that are intrinsically associated to the extreme individualism are unavoidable, and those cannot inhibit the occasional emergence of conditions that, in turn, will favor collectivism. And these crises may be even stronger with time, since sustainable development, by Western standards, is not that feasible to achieve continuously in the future.

The increasing attraction of Western people for Eastern (and frequently collectivistic) ideas, the surge of community values, and even the occasionally extreme shifts towards certain religious groups, are much more than just a superficial trend. Probably, they reflect inherent attempts to satisfy Westerners' suppressed collectivistic needs that are becoming lost in a flourishing individualistic and complex society. And the greater and more interconnected these societies are, the higher the demand for the rediscovery of collectivism will be. Thus, we can predict that Westerners will gradually shift towards some collectivism at some degree. Again, this shift will not be straight and acute, but rather it will be the cumulative outcome of successive cycles of collectivism and individualism. Westerners will have to learn how to live more collectivistically, otherwise they will not be able to function as a unified society. Analogous to that is the conclusion of Tim Jackson (2011), who, based on an economic analysis, argued that the continuous reinforcement of individualism is problematic and a shift towards certain social values should be pursued.

According to Figure 8 , the shift towards collectivism and the conceivable increase in the frequency of the *s* allele in the long run in

Westerners was accompanied by an analogous but opposite shift of Easterners towards individualism and a reduction in the frequency of the *s* allele. Naturally, this is rather hypothetical and by no means indicative for that the "merged" population will simply be the direct and proportional average of the two populations. It is not only that many other genes can affect the state of the final balance, but also that it is very naïve to predict that what is "lost" in terms of collectivism from one population will be gained by the other population. In other words, I doubt that the "homogenized single population" will function that democratically that its constituent subpopulations will contribute equally.

If we go back again to Figure 8 , and given the trend for homogenization of the various cultures and populations in the world, we will be able to predict that the ultimate outcome will be to obtain a heterogeneous but single population that will also show evidence of fluctuations and oscillations. In other words, it is also quite accurate to predict that the high interconnectivity of the various populations that exist around the world will make them able to fluctuate or oscillate together and not independently. This notion of homogeneity, as an ultimate stage of societal organization, has been advocated by various political analysts and philosophers, with Francis Fukuyama (1993) more recently, being one who predicted the *end of history* in his classic and controversial work. In his work, Fukuyama has envisaged the Western-type liberal democracy as the ultimate political state, but again the predominant notion is that of homogeneity that will transcend political administration, financial relationships, and cultures. [2 8]

So, certain periods during which collectivistic behavior will appear as having the predominant role in society will generate unavoidably conditions that will eventually favor individualistic patterns and norms. In turn, these individualistic patterns and attitudes will generate crises that will be resolved by the advancement of collectivistic behaviors. And this will go on until some quite unpredictable and massive event disturbs this equilibrium and pushes this dynamic balance strongly towards the one or the other direction. It has to be noted that these transitions from the individualistic toward collectivistic tendencies will not be guided only by causative changes and selection processes. Other phenomena related to genetic drift and population stratification may also be able to cause analogous changes;

however, it is plausible that the signifying issue is that the whole world's population will tend to behave as more unified as compared to how it behaved in the past.

It is also quite likely that during these processes, some relatively isolated societies will also be generated, or they will continue to exist within the greater global society at which the consequences of this homogenization will have a smaller effect and will be less apparent. The impact, though, of these societies in the global population is anticipated to be relatively small. The populations of the gypsies (Roma) around Europe or that of the Amish people in the U.S.A., offer only some of the many examples of subpopulations of people that despite that they live physically within the borders of a greater society, their cultural and more importantly genetic exchanges with outside people are restricted. These relatively distinct populations and, until the time (and of course, if) they become absorbed by other populations, will continue to function independently; however, the fact that they represent only a minor fraction of the world's population reduces their impact in the global cultural trends.

So, according to Figure 8 , we can predict that in the eventual single "homogenized" populations, cycles of reduction followed by increases in the allelic frequencies of the *s* alleles will periodically occur. For how long these cycles will last, it is obviously hard to predict, but in order to have some balance restored between the peoples' intrinsically dictated attitudes and their cultural and societal norms, by definition they will need to go on for more than a single generation. Otherwise, it is hard to imagine that it will be the same group of people, having the same exact frequencies in their corresponding pool of alleles, which while at first they exhibited a trend for individualistic behavior, they then continued by exhibiting collectivistic patterns and attitudes. Certain changes in the allelic frequencies need to occur, a process that, by definition, and in order to reach a form of stability or equilibrium, requires more than a single generation. This way, the actual "genetic predisposition" and the occurring social structure will maintain a form of balance with each other.

Analogous mechanisms may operate regarding other behavioral traits that exhibit differential tendency, due to certain genetic frequencies,

between East and West. Again, such as in the case of the previously discussed *s* and *l* alleles, the "homogenization" of global society will result in the generation of a single world population that will display evidences of fluctuations and oscillations regarding the allelic frequencies and the corresponding behavioral patterns. The idea is that the increasing efficiency and benefit offered by the one allele of a given polymorphism, at some point will generate conditions that will inhibit its further increase, a point at which the individuals (and the corresponding subpopulations) with the alternative allele will start exhibiting higher benefit and have higher advantage. In turn, at these conditions, this other allele is likely to increase in frequency, generating the cycles of periodic oscillations and fluctuations that eventually will lead to a more homogenous global population with the corresponding overall allelic frequencies in between the original values.

14. Isaac Asimov's Psychohistory: On the Prediction of Historical Decisions

Isaac Asimov, in his *Foundation* series of novels, has introduced the speculative science of psychohistory, a science that by combining history, sociology, and mathematical statistics can make general predictions of future behaviors of very large groups of people. In Asimov's hypothetical universe, with the help of psychohistory, people were able to solve certain crises following the advice of a mathematician by training named Hari Seldon, psychohistory's inventor, developer, and actual practitioner, who appears at specific times at which certain vital decisions should be made. By being able to apply psychohistory's axioms, he was able to predict history and help people render the correct choices and decisions. The success of psychohistorical predictions is heavily based, according to Seldon, on the involvement of large populations that have complete ignorance of the results of the psychohistorical analyses. Only under these conditions is psychohistory able to make accurate and valid predictions.

Equally interesting is that in this hypothetical universe, the original settling of selected colonies destined to maintain humankind and intellect was performed by a selected group of people with specific abilities and skills. Furthermore, within this universe, the author describes two major historical lines (or cultures) of humankind, one based on rational, logic, and scientific advancement (First Foundation), and the other based on individuals with mentalic abilities, telepathy and the ability to adjust human emotions (Second Foundation).

In subsequent books that are related to this virtual universe in which psychohistory is operational, Asimov also implies that the Second Foundation represents the embryonic stage of the development of a collective consciousness, since individuality in this world is not strong and gives way to the needs of the greater whole. The ultimate stage of such collectivism is a complete unification of all elements of the world to a single super-collective entity, exemplified by the concept of *Gaia* . Collectivism, according to Asimov, is not related to logic and scientific advancement.

An imminent similarity with the two actual cultural lines of humanity, of the West and the East, can be identified. The rational, individualistic, and science-prone First Foundation can trace its roots to the Western line of thought, whereas the collectivistic Second Foundation to the Eastern line of thought. Whether Asimov had these specific cultures in mind when shaping his virtual Foundation's universe is hard to know; however, it is conceivable that he might have been influenced by them.

Since we know now that at least a fraction (and likely more than that) of our behavior is due to our genes, we may envisage a scientific discipline, analogous to psychohistory, that would be able to gather and analyze large-scale data and make certain predictions. Interestingly, we can also imagine that in order to render predictions that will be as accurate as possible, data have to involve huge groups of people and also that the individuals constituting these groups should not be aware of the results of this analysis, and thus adjust accordingly their behavior. Otherwise, the results would be biased and inaccurate.

Despite the many and various limitations of this concept, of which only a small subset has been described earlier, some hints regarding future trends can be made. Naturally, all these might be applicable only in cases at which dramatic changes in the genetic composition of the existing populations would not have occurred (see chapters 12 and 13 for details). Otherwise, if populations became unified as regards to their gene frequencies, different behavioral patterns could not have been attributed to a genetic factor. In other words, these may apply prior to the conceivable, previously described "homogenization" of cultures and populations.

By keeping this limitation in our minds, we may be able to foresee certain tendencies. For example, given the advantages of the collectivistic behavior during periods of crises and disasters, we can predict that populations with a tendency to collectivism at such times may exhibit an advantage and higher efficiency. Assuming, for example, that such an event or series of concomitant events have occurred at a global level, it is quite likely that Easterners, that have an inherent tendency for collectivism, would have a certain advantage in terms of being able to function better as a society, or as a whole. The type and the extent of such disastrous events are quite subjective. For example, what for a given society is considered as a regular, though negative, event, in another society may be disastrous. This of course doesn't have to do with the value of individual human life, but rather with how the consequences of such events affected and actually altered the regular functions of the corresponding societies. And this doesn't always have to do with different mentalities, but also to how accustomed the populations are to specific events. Take as an example the consequences of hurricanes in cities around the Gulf of Mexico, geographical regions more familiar to such natural disasters, and imagine what would have happened if such a hurricane hit Athens. Being residents of Greece, we view earthquakes as an event that is not that uncommon as compared to hurricanes. Vice versa, the impact of a strong earthquake might have been much more devastating and scary to the residents of Louisiana. Another example that actually involves populations with different attitudes is related to the way that the Japanese society and state dealt with the recent Fukushima disaster. Try to envisage what would have happened if an analogous event of similar magnitude hit California. In all cases, the examples referred to wealthy Western or Westernized societies, at which the direct consequences of the disasters, at the first instance at least, involved only specific communities and populations. Thus, only indirectly did they have global consequences, but certainly they had imminent effects in the populations that were directly involved.

If we try to imagine the consequences of events of global magnitude, the effects might be much greater. Such events may not necessarily refer to physical and unpredictable sudden disasters, but with intrinsic crises of the current societies. Such crises can be financial, political, or even military. Take, as an example, the recent economical crises that had a domino effect

on economies around the world. If the economical crises of the last years became more intense, persistent, and global, the collectivistic populations might exhibit more efficient approaches and strategies to cope with the potential damages. Such a scenario, on the likelihood of a forthcoming major crisis, according to many economists and political analysis is not that hypothetical and might even be unavoidable.

Analogous and even more apparent may be the consequences of generalized war-like situations and military conflicts at which (and afterwards usually) collectivistic behaviors have certain advantages to exhibit. It is not difficult to imagine that for individualistic societies, socio-economical deterioration is more possible under tense poverty and damaging conditions than for collectivistic societies. The former societal and political structures are more vulnerable than the collectivistic ones because, at some point during the crises, they may attempt to resolute the conflicts and the disputes by changing their intrinsic norms and mode of operation. And while at some point this could be considered as adaptability, after that such changes may lead to instability and disorganization.

On the other hand, for as long as these intense situations and crises at which collectivism is favored do not occur, societies in which the majority of the population is “hardwired” for individualism may have an advantage. Thus, such societies may be more efficient and progressive.

Intuitively speaking, it seems that individualism is good for advancement and development while collectivism for restoration of balances after the occurrence of certain crises—and eventually for damage control! The latter may also be reflected at present times of perceived generalized stability and peace, to the fact that Western-type norms appear very appealing worldwide, despite that at the first instance, the cultural elements they introduce at the various other cultures around the world appear irrelevant to their cultural heritage. Vice versa, the frequent re-discovery of Buddhism by certain celebrities of Western society that appear very successful within their individualistic societies may be relevant to this!

Such consequences of individualism vs. collectivism can be seen at other levels, as well, which do not necessarily involve imminent crises. At the political level, for example, historically liberal societies that have the

Westerners' presumed genetic imprint of the high frequency 7-repeat allele for DRD4 (liberal behavior as described previously) —and who keep on accepting as residents people with lower frequency of this "liberal" allele— may start exhibiting a tendency for conservatism. It is noted at this point that liberalism and conservatism should not be limited to the traditional notions of the current political spectra. In other words, one may be quite conservative in his life and his ideas despite voting for a liberal political party and vice versa, voting for the conservatives but introducing and practicing quite revolutionary ideas. With these issues in mind, at the same time, and given the "en bloc" concept of these tendencies described in detail earlier, such societies may eventually start exhibiting an increased trend of altruism that in its essence is not fully compatible with such societies' competitive and individualistic norms. At the same time, the complex, Western-structured societies which "*worriers* " predominate will have individuals with "warrior"-type behavior increase in numbers. Presumably those, and according to their reduced efficiency under complex socio-economical environments, may shift the societal norms towards directions that are better suited for "warriors." In that case, we (or our great-grandchildren, more likely) may witness changes in the politico-economical systems not intrinsically related to the development of capitalism and liberal democracy per se that can be explained by pure financial and socio-political criteria, but are rather due to the collective outcome of the changes of both the related financial parameters and the genetic constitution of the individuals practicing it.

Analogous will be the challenges for the populations of the collectivistic societies at which individuals besides collectivism also show tendencies for conservatism, lower novelty-seeking and risk-taking, as well as warrior-type behaviors. The fact that they have to operate at societies that require increased novelty-seeking and risk-taking tendencies and ultimately individualism, may generate certain difficulties. Those eventually will have to be solved by shifting the whole societal structures towards the better suited for them collectivistic direction. Alternatively, they may generate, in turn, certain crises that will have to be resolved by more violent and acute ways.

Numerous such examples can be imagined, all of which have as a common denominator the fact that populations with a given genetic composition—and, ultimately, behavioral tendencies and cultural norms—have to adapt within a limited time period to conditions that appear to be better suited for other populations with different genetic frequencies and behavioral tendencies.

Of course, what I described here is a snapshot, and what may have sounded problematic is actually not very different from what constantly happened during history, whenever populations with different cultures—and likely different genetic frequencies—had to interact, blend, or share materials, customs, and genes. Some particularities due to the widest possible extent of today's and likely future trends have been described in some detail in chapter 12. They are all related to what is making us see our contemporary world different from others, or our times more interesting than the past times. In addition to all those, the time periods at which such changes have to occur are likely shorter than before, and they are more massive than what mankind has witnessed in the past, which makes such current changes quite intense. If I were to single out one parameter that distinguishes the perception of the current versus the older times, I would probably choose this one, being the condensation of the events that make time pass faster.

15. Epilogue

The challenging question now, by having such scientific knowledge in our hands—namely to envisage and why or why not—is to predict certain behavioral trends in different populations, if we can minimize certain damages and make the resolution of crises smoother. Such notions, of course, if feasible, extend beyond prediction and hide the notion of the manipulation of human history.

If prediction is achievable, then it is conceivable that, by altering the parameters of the system, one can change the potential outcome. This is consistent to some type of primitive historical engineering, according to which certain historical choices will take into consideration genetic tendencies in order to make the potential outcome as beneficial as possible for those that can perform such analyses. Indeed, unavoidably, this is the foreseen case that may even sound scary, or that recalls specific memories affiliated with very unfortunate moments of human history. However, I don't think that this differs strikingly from the whole concept and deepest essence of technological and scientific progress, according to which by taking advantage of certain physical laws and technological developments, we aim to intervene with various natural phenomena for the benefit of mankind.

The only and deepest danger, though, is that such an approach may reduce the value of individual life to the level of a fraction, or a constituent of a greater whole or specific population. To that end, a clearly fearful outcome is the potential demoralization of certain actions that, presumably for the benefit of mankind (and even worse than that, for the benefit of a group of people or the population), may harm certain individuals.

No matter what, though, the fact is that the genetic identity of a group of people should not be ignored when their history is studied. Besides

geography, availability of natural resources, culture, and socio-economical context in general, the behavior of the people, as it is influenced by their genes, should also be taken into consideration. In view of that, the contribution of the various other parameters involved in human history may acquire a significance that is different from what is traditionally thought.

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Notes

1

The phrase "nature or nurture" returns more than 16 x 10 ^{6} hits in a Google search, which exemplifies the intensity of this debate . It becomes even more complicated when a sharp borderline between the two–or the self and the environment- in certain cases cannot be defined. In that sense, occasionally the individual (self) by being part of the environment manipulates it and thus, strictly speaking, the latter should not be considered as an extrinsic parameter.

2

This is again an oversimplification because certain polymorphisms may benefit, instead of the individual, a group of individuals or the population. Such phenomena are classified under the term of "group selection" and are discussed in the textbooks on evolutionary biology cited earlier. In that case, the essential issue is related to the identification of what the actual subject of evolution is, namely the individual, the group or the genes.

3

The web site of "International Commission on Zoological Nomenclature" is http://iczn.org/category/faqs/frequently-asked-questions/who-type-homo-sapiens and at this one can find the official name of all animals. In this site (http://taxonomicon.taxonomy.nl/TaxonList.aspx?subject=Taxon&by=ScientificName&search=homo+sapiens *,) variations of the human species according to Linnaeus are being described.

4

The classification of *Homo monstrosus* as a distinct species from *Homo sapiens* has also been proposed by *Linneaus* .

5

Two-feet standing or *bipedalism* has not developed only in apes but at other times during evolution, such as in macropods that include the kangaroos. Bipedal dinosaurs have also occurred and the birds are the evolutionary descendents of these now extinct species.

6

The following link provides an overview of our current notion regarding human speciation and that favors the Out-of-Africa as opposed the multiregionalism hypothesis. It has been copied from the American Institute of Biological Sciences that noteworthy, as a subheading has the statement: Bringing biology to informed decision making. http://www.actionbioscience.org/evolution/johanson.html)

7

This “go together” tendency for certain behavioral and other traits is different from the genetic linkage that is due to the fact that 2 polymorphic genes are physically close in the chromosomes. Thus, the corresponding traits co-segregate in the offspring. A measurement of this genetic distance is obtained by assessing the degree of recombination between these alleles.

8

This term refers to a set of genetic markers that due to their proximity tend to be inherited together. It may refer to either genomic (in chromosomes) or mitochondrial markers.

9

The exact cause of death of Alexander the Great in Babylon, in 323 BC remains inconclusive. Among various potential causes, the usual suspects that included malaria and typhoid fever have been suggested, along with

others such as pancreatitis, West Nile virus infection, syphilis and even assassination.

10

A fire in Oldsmobile manufacturing facility in 1901 destroyed all but one prototypes. Among them luxurious or other exotic cars were included. The one that survived the fire was a so called *Curved Dash* that was placed near the exit and was developed with the intension to target the average American consumer that needed a simple and cheap car. The manufacturing and commercial future of Oldsmobile was shaped by this prototype that survived the fire and the legacy was continued even after its purchase of Oldsmobile from General Motors in 1929 (actually being part of the General Motors' companion make program) and was making relatively cheap cars for the average American.

11

Naturally, direct comparison between individuals and populations is like comparing eggs and apples. The meaning here is that by knowing the genotype of an individual it is possible to compare it with certain populations' allelic frequencies and extract conclusions regarding how common or uncommon the corresponding individual's alleles are. This information can be interpreted as a similarity to this specific population.

12

In 2009 a Pilot Project was initiated in order to distinguish Somali asylum seekers from other Africa nations, based on the results of DNA analyses. Following criticism from many directions the Project was cancelled in 2011 .

(http://blogs.nature.com/news/2011/06/uk_immigration_cancels_dna_scr_1.html).

13

Direct to consumers DNA tests refer to the DNA tests that are accessible directly to the consumer without having to go through a health care professional. Several controversies have been triggered regarding these tests, in principle related to the possible misinterpretation of the results by the consumers. In 2010, the *Walgreens* pharmacy store in the U.S. postponed providing genetic tests through its drugstores after the Food and Drug Administration challenged the legality of the test.
http://www.nytimes.com/2010/05/13/health/13gene.html

14

Representative and widely known sayings of Heraclitus are the: "*No man ever steps in the same river twice, for it's not the same river and he's not the same man* " and "*Everything changes, and nothing abides* ".

15

The discussion about the true motives of religious wars starting from the Crusades during the Middle Ages, until the religious wars in Modern and contemporary societies is a matter of debate and depending on the specific view point various different deeper motives may be identified. However, undoubtedly a great role was also played by the strong belief that they served a greater cause, for which for which religious rightness was instrumental.

16

The following link provides a lively presentation of the "6 killer Western applications" by the author Niall Fergusion.
http://macromon.wordpress.com/2011/11/04/niall-ferguson-the-6-killer-apps-of-prosperity/

17

An interesting article by M. Brooks that appeared in the New Statement in 16/08/2010 and entitled "The spark rises in the east" discusses the recent investment of China to science.
http://www.newstatesman.com/asia/2010/08/china-research-chinese-science

. Among other issues, in this interesting article, the fact that hierarchical Eastern traditions have to give way to more liberal practices is proposed, as a perquisite for the success of this effort. Noteworthy, the rigid hierarchal structure is integral to the collectivistic societies.

18

It could be argued that various remarkable accomplishments and human artifacts of these Central and South American civilizations, such as the Aztec's calendar sunstone and the Mayan astronomy may indeed indicate evidence for scientific advancement. However, in our case we focus on the curiosity-driven science that is based in logic and rational. Probably, future archeological research will better understand the essence of these accomplishments and categorize them as evidence of scientific progress, which in turn may resolve this phenomenological discrepancy.

19

President's Obama statement of 01/21/2010 on economic crisis can be found in: http://www.ft.com/cms/s/0/26e0f512-06b4-11df-b426-00144feabdc0.html#axzz1Yaht FSLY

20

Harm avoidance is a behavioral trait for which individuals with high scores are described as worrying and pessimistic, fearful and doubtful, shy, and fatigable. The personality theorist R.C. Cloninger (Stallings et al, 1996) proposed that *harm avoidance* , along with *novelty seeking, persistence* , and *reward dependence* constitute the four temperamental dimensions. It is noted that in this classification, persistence was added at a subsequent point as soon as it was realized that it represents an independent factor.

21

Surui, Karitiana and the *Ticuna* are indigenous populations of South America. The population of the Suruis today is about 1000, of the Karitianas about 300 while of the Ticuna Indians about 35000 individuals. The reservations for all of these people are in the Amazon rainforest.

22

The HapMap project is a large scale worldwide genetic project that records and studies the genetic variation among different world populations. (http://hapmap.ncbi.nlm.nih.gov/index.html.en).

23

These are only some of the ethnic groups found in Africa. Yoruba people are about 30 millions and are found to West Africa. Maasai and Luhya are found in Kenya and Tanzania and are estimated to about 1.5 millions and 6.5 millions respectively.

24

In theory, having DNA samples from certain populations representing different points of historical time may have allowed recording of such periodic variation of allelic frequencies. However, the major limitation is that population migration phenomena are quite likely to have masked the potential periodic changes in allelic frequencies. In other words we would not be able to interpret *s* alleles' increases to the advantage of *s* -allele bearing individuals or to the migration of *s* -allele bearing individuals into this population.

25

The term "*butterfly effect* " was coined by the mathematician and meteorologist Edward Norton Lorenz in order to describe that a small change at one place in a nonlinear system can result in large differences to a later state. The illustrative analogy is related to the flapping of the wings of a butterfly that can cause hurricane elsewhere.

26

Certain groups of people have lived in isolation for considerable time periods. Aboriginals in Australia for example are thought to represent the oldest group of people outside Africa that resembles genetically the original pre-historic settlers of this area. These groups and populations though,

while devoid to considerable gene exchanges from outside populations, they were quite limited arithmetically so they could not account for the development of cultures that have emerged to defined civilizations, at least of the magnitude of others.

27

Non-random mating between individuals of the same population results in systematic differences in the allelic frequencies between subpopulations, a phenomenon designated as *population stratification* . It can be due to physical separation, the existence of cultural barriers and all other factors that may induce non-random mating. It is eliminated after prolonged periods of non-selective mating.

28

Issues related to the creation of an open national identity, a perquisite for smooth and efficient cultural homogenization, especially in view of currently occurring immigration and how it was dealt in Europe as compared to U.S.A. and Canada are being discussed by Fukuyama in "Identity, immigration and liberal democracy" that appeared in the "*Journal of Democracy* " 17 , 2, April 2006 .